



2H Hydraulic Cylinders

Heavy Duty NFPA Tie Rod Cylinders for
Working Pressures up to 210 bar

aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

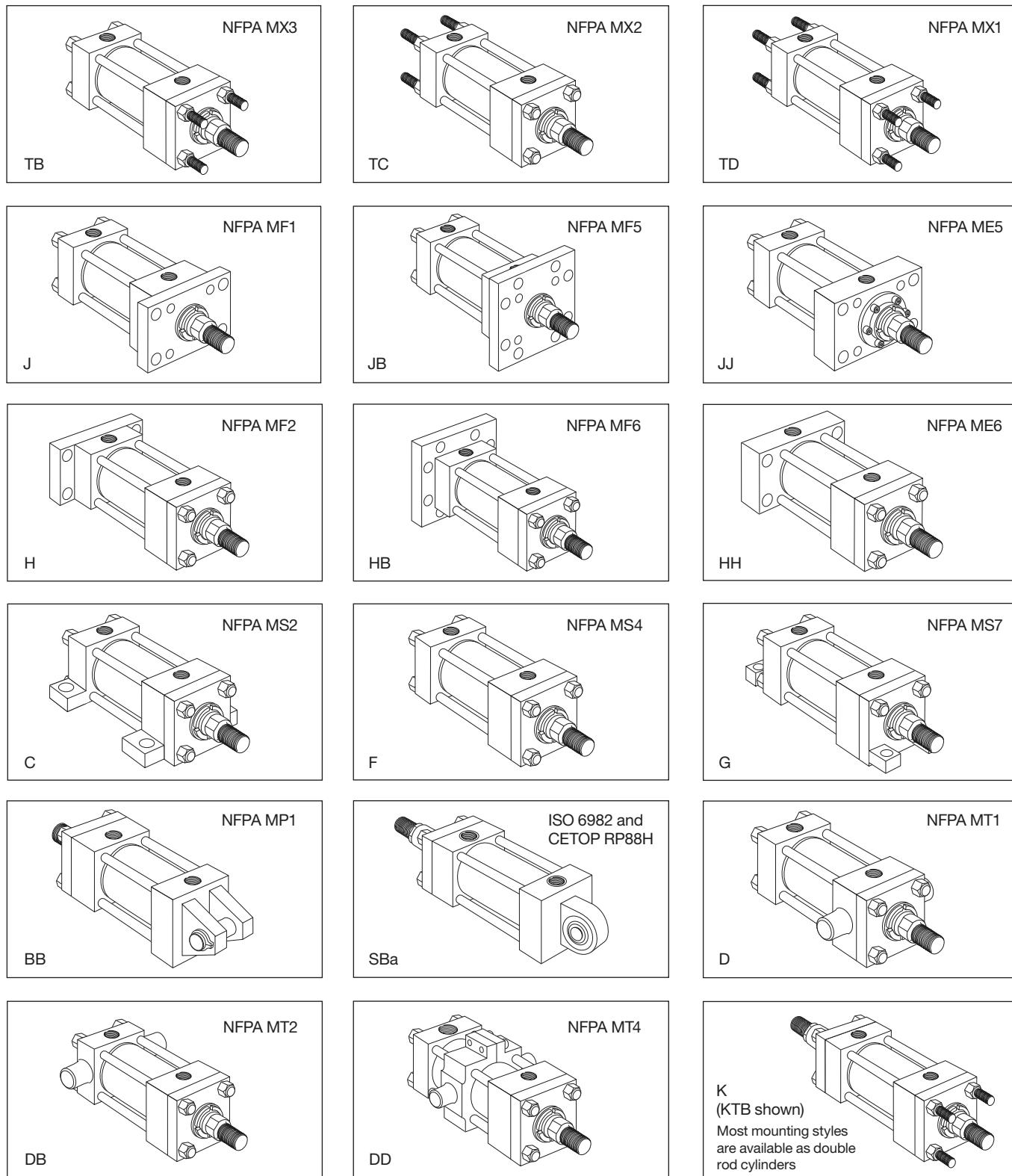


ENGINEERING YOUR SUCCESS.

2H Cylinder Mounting Styles

The standard range of Parker 2H cylinders comprises 17 mounting styles. Dimensional information for each mounting style is shown on pages 10-21 for 38.1mm to 203.2mm (1½" to 8") bore sizes, and on pages 22-25 for 254mm and 304.8mm (10" and 12") bore sizes.

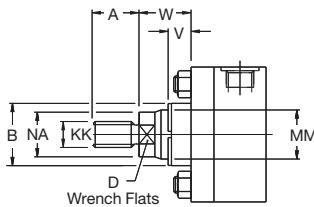
Application-specific mounting information is shown on page 31. Where a non-standard mounting style is required, please contact the factory for details.



38.1mm to 203.2mm (1½" to 8") Bores Only

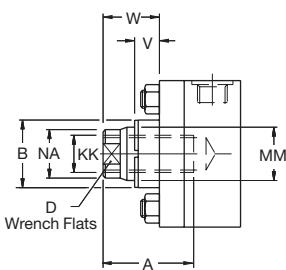
Rod End Styles 4, 7 & 8

- All Except JJ Mount



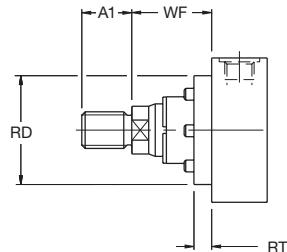
Rod End Style 9

- All Except JJ Mount



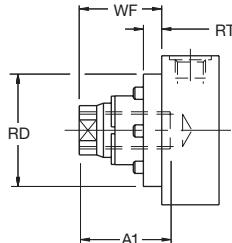
Rod End Styles 4, 7 & 8

- JJ Mount Only



Rod End Style 9

- JJ Mount Only



Rod End Styles 4 & 8

The standard rod end, Style 4, is recommended for all applications in which the work piece is secured against the rod shoulder. Where the work piece is not shouldered, Style 8 rod ends are recommended.

Rod End Style 9

For applications where a female thread is required.

Rod End Style 3

Non-standard piston rod ends are designated 'Style 3'. A dimensional sketch or description should accompany the order. Please specify dimensions KK and A.

Rod End Style 7

Style 7 rod ends apply to rod eyes with spherical bearings only (see pages 27 and 29). The Style 7 rod end with spherical bearing allows the same diameter pivot pin to be used at both the head and cap ends of the cylinder. For Style 7 rod end thread lengths, please refer to dimension A1 in the table below.

Style JJ

Dimensions which are not shown are identical to those shown for the equivalent non-JJ design.

Rod End Dimensions – 38.1mm to 203.2mm (1½" to 8") bore sizes only

| Bore Ø | Rod No. | MM Rod Diameter | Style 4 & 9 | | Style 8 | | Style 7 ² | | A | B ^{+0.00 -0.05} | D | NA | V | W | JJ Mount Only | | |
|------------|---------|-----------------|-------------|---------------------|-----------|----------|----------------------|----|-------|--------------------------|-----|-------|------|------|---------------|------|------|
| | | | KK Metric | KK UNF ¹ | KK Metric | KK UNF | KK Metric | A1 | | | | | | | RD max. | RT | WF |
| 38.1 | 1 | 15.9 (1½") | M10x1.5 | 7/16 - 20 | M12x1.5 | 1/2 - 20 | M16x1.5 | 21 | 19.0 | 28.55 | 13 | 14.3 | 6.4 | 15.9 | 54.0 | 9.5 | 25.4 |
| | 2 | 25.4 (1") | M20x1.5 | 3/4 - 16 | M22x1.5 | 7/8 - 14 | | | 28.6 | 38.07 | 22 | 23.8 | 12.7 | 25.4 | | | |
| 50.8 | 1 | 25.4 (1") | M20x1.5 | 3/4 - 16 | M22x1.5 | 7/8 - 14 | M20x1.5 | 27 | 28.6 | 38.07 | 22 | 23.8 | 6.4 | 19.1 | 63.5 | 9.5 | 35.0 |
| | 2 | 34.9 (1¾") | M26x1.5 | 1 - 14 | M30x2 | 1¼ - 12 | | | 41.3 | 50.77 | 30 | 33.3 | 9.5 | 25.4 | | | |
| 63.5 (2½") | 1 | 25.4 (1") | M20x1.5 | 3/4 - 16 | M22x1.5 | 7/8 - 14 | M27x2 | 35 | 28.6 | 38.07 | 22 | 23.8 | 6.4 | 19.1 | 63.5 | 9.5 | 35.0 |
| | 2 | 44.5 (1¾") | M33x2 | 1¼ - 12 | M39x2 | 1½ - 12 | | | 50.8 | 60.30 | 36 | 42.9 | 12.7 | 31.8 | | | |
| | 3 | 34.9 (1¾") | M26x1.5 | 1 - 14 | M30x2 | 1¼ - 12 | | | 41.3 | 50.77 | 30 | 33.3 | 9.5 | 25.4 | | | |
| 82.6 (3¼") | 1 | 34.9 (1¾") | M26x1.5 | 1 - 14 | M30x2 | 1¼ - 12 | M33x2 | 44 | 41.3 | 50.77 | 30 | 33.3 | 6.4 | 22.2 | 76.2 | 9.5 | 41.3 |
| | 2 | 50.8 (2") | M39x2 | 1½ - 12 | M45x2 | 1¾ - 12 | | | 57.1 | 66.65 | 41 | 49.2 | 9.5 | 31.8 | | | |
| | 3 | 44.5 (1¾") | M33x2 | 1¼ - 12 | M39x2 | 1½ - 12 | | | 50.8 | 60.30 | 36 | 42.9 | 9.5 | 28.6 | | | |
| 101.6 (4") | 1 | 44.5 (1¾") | M33x2 | 1¼ - 12 | M39x2 | 1½ - 12 | M42x2 | 55 | 50.8 | 60.30 | 36 | 42.9 | 6.4 | 25.4 | 88.9 | 9.5 | 47.7 |
| | 2 | 63.5 (2½") | M48x2 | 17/8 - 12 | M56x2 | 2¼ - 12 | | | 76.2 | 79.35 | 55 | 60.3 | 9.5 | 34.9 | | | |
| | 3 | 50.8 (2") | M39x2 | 1½ - 12 | M45x2 | 1¾ - 12 | | | 57.1 | 66.65 | 41 | 49.2 | 6.4 | 28.6 | | | |
| 127.0 (5") | 1 | 50.8 (2") | M39x2 | 1½ - 12 | M45x2 | 1¾ - 12 | M42x2 | 62 | 57.1 | 66.65 | 41 | 49.2 | 6.4 | 28.6 | 101.6 | 15.9 | 50.8 |
| | 2 | 88.9 (3½") | M64x2 | 2½ - 12 | M76x2 | 3¼ - 12 | | | 88.9 | 107.92 | 75 | 85.7 | 9.5 | 34.9 | | | |
| | 3 | 63.5 (2½") | M48x2 | 17/8 - 12 | M56x2 | 2¼ - 12 | | | 76.2 | 79.35 | 55 | 60.3 | 9.5 | 34.9 | | | |
| | 4 | 76.2 (3") | M58x2 | 2¼ - 12 | M68x2 | 2¾ - 12 | | | 88.9 | 95.22 | 65 | 73.0 | 9.5 | 34.9 | | | |
| 152.4 (6") | 1 | 63.5 (2½") | M48x2 | 17/8 - 12 | M56x2 | 2¼ - 12 | M64x3 | 84 | 76.2 | 79.35 | 55 | 60.3 | 6.4 | 31.8 | 114.3 | 15.9 | 57.2 |
| | 2 | 101.6 (4") | M76x2 | 3 - 12 | M95x2 | 3¾ - 12 | | | 101.6 | 120.62 | 85 | 98.4 | 6.4 | 31.8 | | | |
| | 3 | 76.2 (3") | M58x2 | 2¼ - 12 | M68x2 | 2¾ - 12 | | | 88.9 | 95.22 | 65 | 73.0 | 6.4 | 31.8 | | | |
| | 4 | 88.9 (3½") | M64x2 | 2½ - 12 | M76x2 | 3¼ - 12 | | | 88.9 | 107.92 | 75 | 85.7 | 6.4 | 31.8 | | | |
| 177.8 (7") | 1 | 76.2 (3") | M58x2 | 2¼ - 12 | M68x2 | 2¾ - 12 | M64x3 | 84 | 88.9 | 95.22 | 65 | 73.0 | 6.4 | 31.8 | 133.4 | 15.9 | 57.2 |
| | 2 | 127.0 (5") | M90x2 | 3½ - 12 | M110x2 | 4¾ - 12 | | | 127.0 | 146.02 | 110 | 123.8 | 6.4 | 31.8 | | | |
| | 3 | 88.9 (3½") | M64x2 | 2½ - 12 | M76x2 | 3¼ - 12 | | | 88.9 | 107.92 | 75 | 85.7 | 6.4 | 31.8 | | | |
| | 4 | 101.6 (4") | M76x2 | 3 - 12 | M95x2 | 3¾ - 12 | | | 101.6 | 120.62 | 85 | 98.4 | 6.4 | 31.8 | | | |
| 203.2 (8") | 1 | 88.9 (3½") | M64.2 | 2½ - 12 | M76x2 | 3¼ - 12 | M64x3 | 84 | 88.9 | 107.92 | 75 | 85.7 | 6.4 | 31.8 | 146.1 | 15.9 | 57.2 |
| | 2 | 139.7 (5½") | M100x2 | 4 - 12 | M130x2 | 5¼ - 12 | | | 139.7 | 158.72 | 120 | 136.5 | 6.4 | 31.8 | | | |
| | 3 | 101.6 (4") | M76x2 | 3 - 12 | M95x2 | 3¾ - 12 | | | 101.6 | 120.62 | 85 | 98.4 | 6.4 | 31.8 | | | |
| | 4 | 127.0 (5") | M90x2 | 3½ - 12 | M110x2 | 4¾ - 12 | | | 127.0 | 146.02 | 110 | 123.8 | 6.4 | 31.8 | | | |
| | 5 | 127.0 (5") | | | | | | | | | | | | | 190.5 | 25.4 | 57.2 |

¹ All rod threads are UNF except 1" - 14 which is UNS.² Style 7 threads apply to spherical rod eyes only, see pages 27 and 29.

All dimensions are in millimetres unless otherwise stated.

Storage

When cylinders must be stored for a period of time, the following procedures are recommended:

1. Store the cylinders in an indoor area which has a dry, clean and non-corrosive atmosphere. Take care to protect the cylinder from both internal corrosion and external damage.
2. Whenever possible, cylinders should be stored in a vertical position (piston rod up). This will minimize corrosion due to possible condensation which could occur inside the cylinder.
3. Port protector plugs should be left in the cylinder until the time of installation.

Installation

1. Cleanliness is an important consideration, and Parker cylinders are shipped with the ports plugged to protect them from contaminants entering the ports. These plugs should not be removed until the piping is to be installed. Before making the connection to the cylinder ports, piping should be thoroughly cleaned to remove all debris which might have resulted from threading or flaring operations.
2. Cylinders operating in an environment where air drying materials are present such as fast-drying chemicals, paint, or weld splatter, or other hazardous conditions such as excessive heat, should have shields installed to prevent damage to the piston rod and piston rod seals.
3. Correct alignment of the cylinder piston rod and its mating component on the machine should be checked in both the extended and retracted positions. Incorrect alignment will result in excessive rod gland and/or cylinder bore wear, shortening the life of the cylinder.

Masses – Series 2H Cylinders

To determine the mass of the cylinder, first select the basic mass for zero stroke, then calculate and add the mass for the appropriate stroke length. Masses for accessories are shown on pages 27 to 29.

| Bore Ø | Rod No. | Single Rod Cylinders | | | Double Rod Cylinders | | |
|----------------|------------------|--------------------------|--------------------------|-------------------------------------|--------------------------|--------------------------|-------------------------------------|
| | | Mass at Zero Stroke | | Mass per 10mm Stroke kg | Mass at Zero Stroke | | Mass per 10mm Stroke kg |
| | | Mounting Styles | Mounting Styles | | Mounting Styles | Mounting Styles | |
| 38.1 (1½") | 1 2 | 3.6 3.7 | 4.7 4.9 | 0.09 0.11 | 4.1 4.4 | 5.23 5.53 | 0.10 0.15 |
| 50.8 (2") | 1 2 | 5.7 6.0 | 7.5 7.8 | 0.14 0.18 | 6.9 7.5 | 8.74 9.34 | 0.18 0.25 |
| 63.5 (2½") | 1 2 3 | 7.9 8.7 8.2 | 10.1 11.0 10.8 | 0.19 0.27 0.22 | 9.4 11.0 10.0 | 11.7 13.3 12.7 | 0.23 0.39 0.30 |
| 82.6 (3¼") | 1 2 3 | 15.2 16.1 15.7 | 19.4 20.4 19.9 | 0.31 0.39 0.36 | 18.2 20.0 19.2 | 22.5 24.3 23.5 | 0.39 0.55 0.48 |
| 101.6 (4") | 1 2 3 | 20.4 22.2 20.8 | 25.7 27.5 26 | 0.39 0.51 0.42 | 25 29 26 | 31 35 32 | 0.51 0.76 0.58 |
| 127.0 (5") | 1 2 3 4 | 36 41 37 39 | 44 49 46 47 | 0.59 0.92 0.68 0.79 | 43 53 46 49 | 52 62 55 58 | 0.75 1.40 0.93 1.20 |
| 152.4 (6") | 1 2 3 4 | 58 64 60 62 | 71 77 73 75 | 0.92 1.3 1.1 1.2 | 68 80 71 74 | 82 94 85 88 | 1.2 2.0 1.4 1.7 |
| 177.8 (7") | 1 2 3 4 | 86 97 88 90 | 105 116 107 109 | 1.2 1.8 1.3 1.4 | 99 122 103 108 | 119 142 123 128 | 1.5 2.8 1.8 2.1 |
| 203.2 (8") | 1 2 3 4 | 120 135 123 130 | 145 160 148 155 | 1.6 2.3 1.8 2.1 | 137 166 142 157 | 163 192 168 183 | 2.1 3.5 2.4 3.1 |
| 254.0 (10") | 1 2 | 275 291 | 328 344 | 3.0 4.0 | 325 357 | 378 410 | 4.0 5.9 |
| 304.8 (12") | 1 2 | 444 474 | 527 557 | 3.9 5.6 | 519 579 | 603 663 | 5.1 8.4 |

Warning

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries, sales offices and authorized distributors provide product or system options for further investigation by users having technical expertise. Before you select or use any product or system it is important that you analyse all aspects of your application and review the information concerning the product or system in the current product catalogue. Due to the variety of operating conditions and applications for these products or systems, the user, through his own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance and safety requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

Offer of Sale

Please contact your local Parker representative for a detailed offer of sale.

All dimensions are in millimetres unless otherwise stated.

Parker Offers the Widest Range of Industrial Cylinders

High Productivity – Low Cost of Ownership

Parker Hannifin's Cylinder Division is the world's largest supplier of hydraulic cylinders for industrial applications.

Parker manufactures a vast range of standard and special tie rod, roundline and 'mill' type cylinders to suit all types of industrial cylinder applications. Our cylinders are available to ISO, DIN, NFPA, ANSI and JIC standards, with other certifications available on request. All Parker hydraulic cylinders are designed to deliver long, efficient service with low maintenance requirements, guaranteeing high productivity year after year.

About Parker Hannifin

Parker Hannifin is the global leader in motion and control technologies, partnering with its customers to increase their productivity and profitability. The company employs more than 52,000 people in 48 countries around the world, providing customers with technical excellence and first class customer service.

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Standard Specifications

- Heavy-duty service – ANSI B93.15-1987 and NFPA specifications
- Standard construction – square end, tie rod design
- Standard pressure – 210 bar
- Standard fluid – hydraulic mineral oil
- Standard temperature – -20°C to 80°C (-4°F to 176°F)

Tie Rod Cylinders

2H Series

Contents

| | Page |
|---|------|
| Piston Rod End Data – | |
| 38.1mm to 203.2mm (1½" to 8") bores | 3 |
| Storage Information & Mass Data | 4 |
| Standard Specifications | 5 |
| Design Features and Benefits | 6 |
| | |
| Cylinder Selection Check List | 8 |
| Mounting Styles | 9 |
| Double Rod Cylinders | 26 |
| Accessories | 27 |
| Mounting Information | 30 |
| Push and Pull Forces | 32 |
| Piston Rod Sizes & Stop Tubes | 33 |
| Stroke Factors & Long Stroke Cylinders | 34 |
| Cushioning | 35 |
| Pressure Limitations | 36 |
| Ports, Locations and Piston Speeds | 36 |
| Seals & Fluids | 38 |
| Optional Features | 39 |
| Replacement Parts and Service | 40 |
| Repairs | 41 |
| Piston Rod End Data – | |
| 254.0mm and 304.8mm (10" and 12") bores | 42 |
| How to Order Cylinders | 43 |

The 2H Cylinder Range

The 2H cylinders described in this catalogue are heavy duty hydraulic cylinders rated for use at working pressures up to 210 bar depending on the rod end and type of service.

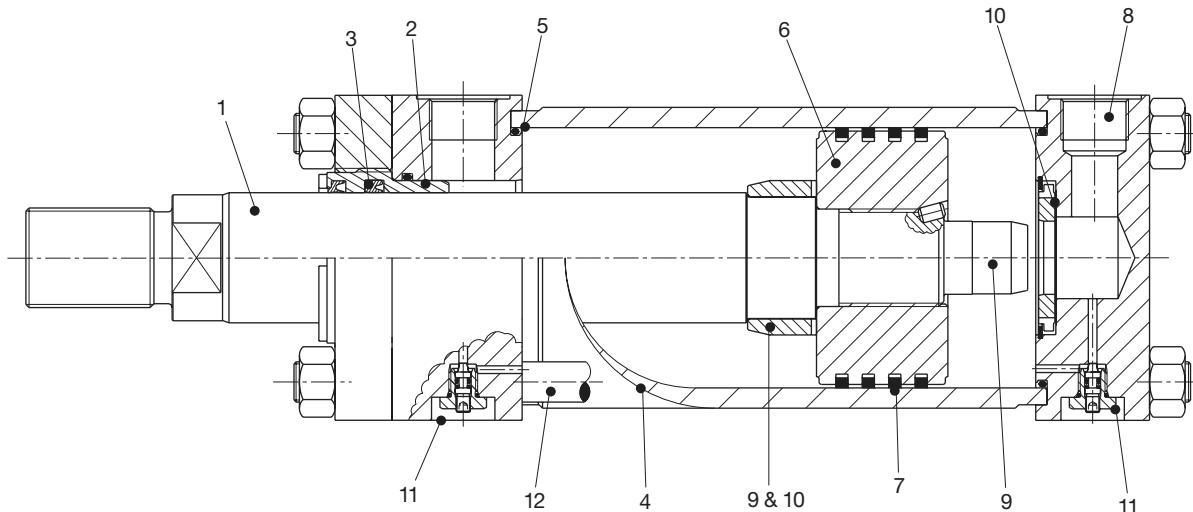
In addition to the standard cylinders featured in this catalogue, 2H cylinders can be designed to suit customer requirements. Our engineers will be pleased to advise on unique designs to suit specific applications.

inPHorm and 3-D CAD

Parker offers easy-to-use software to simplify the cylinder selection process, saving your time and ensuring the accuracy of designs and drawings. InPHorm selection software and new 3-D CAD modelling software can be downloaded from our Cylinder Division Europe website.

Please visit us at www.parker.com or contact your local Sales Office for more information.

- Bore sizes – 38.1mm (1½") to 304.8mm (12")
- Piston rod diameters – 15.9mm (5/8") to 215.9mm (8½")
- Mounting styles – 17 standard styles
- Strokes – available in any practical stroke length
- Cushions – optional at either end or both ends of stroke
- Rod ends – three standard choices – specials to order



1 Piston Rod

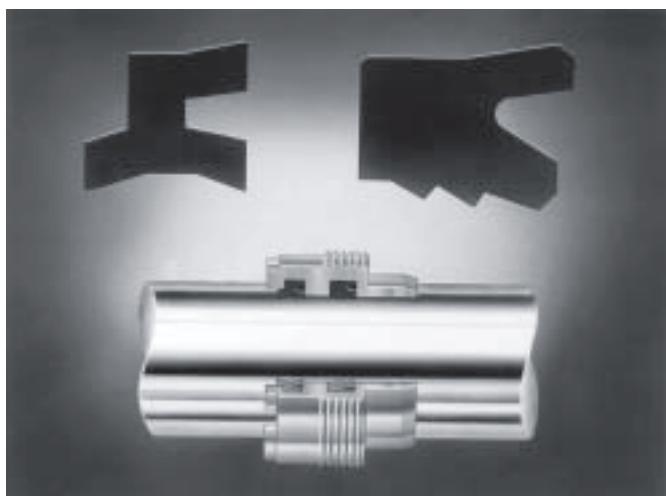
Gland seal life is maximised by manufacturing piston rods from precision ground, high tensile carbon alloy steel, hard chrome plated and polished to $0.2\mu\text{m}$ max. Piston rods are induction case hardened to Rockwell C54 minimum before chrome plating, resulting in a dent-resistant surface.

2 Parker's Rod Gland

Continuous lubrication, and therefore longer gland life, are provided by the long bearing surface inboard of the lipseal. The gland, complete with rod seals, can easily be removed without dismantling the cylinder, so servicing is quicker – and therefore more economical.

3 Rod Seals

The serrated lipseal has a series of sealing edges which take over successively as pressure increases, providing efficient sealing under all operating conditions. On the return stroke the serrations act as a check valve, allowing the oil adhering to the rod to pass back into the cylinder.



The double lip wiperseal acts as a secondary seal, trapping excess lubricating film in the chamber between the wiper and lip seals and preventing the ingress of dirt into the cylinder, extending the life of gland and seals. Standard lipseals are manufactured from an enhanced polyurethane, giving efficient retention of

fluid and a life of up to five times that of traditional seal materials. Standard rod seals are suitable for speeds up to 0.5m/s – special seal combinations are available for higher speed applications.

4 Cylinder Body

Strict quality control standards and precision manufacture ensure that all tubes meet rigid standards of straightness, roundness and surface finish. The steel tubing is surface finished to minimise internal friction and prolong seal life.

5 Cylinder Body Seals

To ensure that the cylinder body remains leak free, even under pressure shock conditions, Parker fits pressure-energised body seals.

6 Piston

All pistons are of one-piece type, and feature wide bearing surfaces to resist side loading. Long thread engagement secures the piston to the piston rod and, for additional safety, the piston is secured by thread-locking adhesive and a locking pin.

7 Piston Seals

Cast Iron Piston Rings are extremely durable but allow some leakage across the piston and cannot therefore hold a load in position. Cast iron piston rings are fitted as standard on series 2H hydraulic cylinders.

Lipseal Pistons can hold a load in position, but are not as durable as pistons with cast iron rings or Hi-Load seals. For applications with a working pressure in excess of 140 bar where the duty cycle requires sustained piston speeds in excess of 0.4m/s or high cycling performance, other seal options should also be considered. Where these performance criteria may be exceeded, please contact the factory with details of the application.

Hi-Load Pistons resist side loading and are recommended for long stroke cylinders, especially when pivot mounted. Special wear rings prevent metal-to-metal contact between the piston and tube and thereby extend the life of the cylinder.

Low Friction Seals are also available – see page 37.

8 Ports

High piston speeds allow rapid cycling, which maximises machine productivity. Parker offers a range of port sizes to permit different flow rates, in all common inch and metric standards. Choosing the correct port size simplifies design and installation, and cuts maintenance time to a minimum.

9 Cushioning

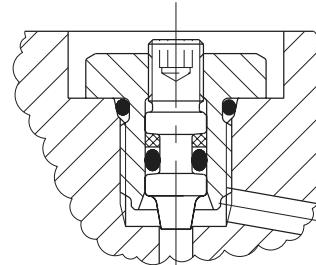
Progressive deceleration reduces both noise and shock, prolonging machine life and improving the working environment. Parker 2H cylinders are available with stepped cushions at the head and cap, which decelerate a load safely while optimising the cycling rate of the process. The head and cap end cushions are self centring. The polished cap end spear is an integral part of the piston rod.

10 Floating Cushion Bushes & Sleeves

Closer tolerances – and therefore more effective cushioning – are permitted by the use of a floating cushion sleeve at the head end of the cylinder, and a floating cushion bush at the cap end. A specially designed cushion sleeve on bore sizes up to 101.6mm (4") operates as a check valve. On larger bore sizes a conventional ball check valve is used. The use of a check valve in the head and lifting of the bronze cushion bush in the cap, provides minimum fluid flow restriction at the start of the return stroke. This allows full pressure to be applied over the whole area of the piston, to provide full power and fast cycle times.

11 Cushion Adjustment

Needle valves are provided at both ends of the cylinder for precise cushion adjustment, and retained within the head and cap so that they cannot be inadvertently removed. The cartridge type needle valve illustrated is fitted to cylinders of up to 63.5mm (2½") bore. See page 35 for location.



12 Tie Rod Construction

Tie rod construction, with tie rods torque-loaded on assembly, imposes a compressive force on the cylinder tube which counters the tensile forces generated by system pressure. The result – a fatigue-free cylinder with long service life and exceptionally compact dimensions.

Seal Classes

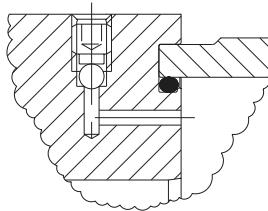
To accommodate the many types of fluid and the varying temperature ranges used in industry, Parker offers a range of rod gland, piston and body seals moulded in different profiles and from different materials. These are described in detail on page 37.

Special Designs

Parker's design and engineering staff are available to produce special designs to meet customer's specific requirements. Alternative sealing arrangements, special mounting styles, different bores and rod sizes are just a few of the custom features which can be supplied.

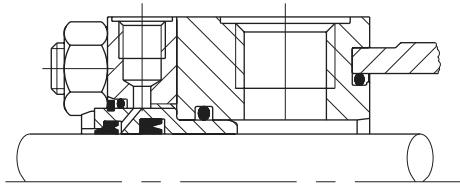
Air Bleeds

The option of air bleeds is available at either or both ends of the cylinder, at any position except in the port face – see page 35 for location. To ensure operator safety, the standard M8 air bleed screw (illustrated) is recessed into the head and cap and retained so that it cannot be inadvertently removed.



Gland Drains

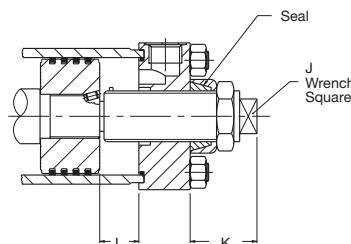
The accumulation of fluid between the gland seals of long stroke cylinders, cylinders with constant back pressure or where the ratio of the extend speed to the retract speed is greater than 2 to 1, can be relieved by specifying an optional gland drain. A transparent tube fitted between the gland drain and the reservoir allows fluid loss from concealed or inaccessible cylinders to be monitored, giving an early indication of the need for gland servicing.



A $1\frac{1}{8}$ " NPTF gland drain port can be provided in the retainer on all cylinders up to and including 203.2mm (8") bore sizes, except 38.1mm (1 $\frac{1}{2}$ ") with no. 1 rod. For 38.1mm (1 $\frac{1}{2}$ ") bore cylinders with no.2 rod, the retainer thickness is increased to 15.9mm ($\frac{5}{8}$ "). For 38.1mm (1 $\frac{1}{2}$ ") bore cylinders with no.1 rod, the drain port is located in the head end adjacent to the port.

Stroke Limiters

Where absolute precision in stroke length is required, a screwed adjustable stop can be supplied at the cap end. Several types are available – the illustration shows a design suitable for infrequent adjustment of an uncushioned cylinder. Please contact the factory, specifying details of the application and the adjustment required.



| Bore Ø |
|--------------------------|
| 38.1 (1 $\frac{1}{2}$ ") |
| 50.8 (2") |
| 63.5 (2 $\frac{1}{2}$ ") |
| 82.6 (3 $\frac{1}{4}$ ") |
| 101.6 (4") |
| 127.0 (5") |
| 152.4 (6") |
| 177.8 (7") |
| 203.2 (8") |

| J | K min. | L max. |
|----|--------|--------|
| 11 | 55 | 127.0 |
| 17 | 75 | 203.2 |
| 17 | 75 | 228.6 |
| 22 | 85 | 228.6 |
| 24 | 70 | 457.2 |
| 32 | 70 | 508.0 |
| 41 | 75 | 508.0 |
| 50 | 75 | 508.0 |
| 60 | 80 | 508.0 |

Rod Locking Devices

These units provide positive locking of the piston rod. They require hydraulic pressure to release, while loss of pressure causes the clamp to operate, allowing them to be used as a fail-safe device. Please consult the factory for further information.

Single-Acting Cylinders

Standard 2H series cylinders are of the double-acting type. They are also suitable for use as single-acting cylinders, where the load or other external force is used to return the piston after the pressure stroke. Cast iron piston rings should not be used with single-acting cylinders.

Spring-Returned, Single-Acting Cylinders

Single-acting cylinders can be supplied with an internal spring to return the piston after the pressure stroke. Please supply details of load conditions and friction factors, and advise whether the spring is required to advance or return the piston rod.

On spring-returned cylinders, it is recommended that tie rod extensions be specified to allow the spring to be 'backed off' until compression is relieved. Please consult the factory when ordering spring-returned cylinders.

Multiple Stroke Positioning

To obtain linear force in one plane with controlled stopping at intermediate points, several designs are available. For three stopped positions, it is common practice to mount two standard single rod Style H cylinders back-to-back, or to use through-tie rods. By extending or retracting the stroke of each cylinder independently, it is possible to achieve three positions at the piston ends. An alternative technique is to use a tandem cylinder with an independent piston rod in the cap section. Please consult the factory for further details.

Rod End Bellows

Unprotected piston rod surfaces which are exposed to contaminants with air hardening properties should be protected by rod end bellows. Longer rod extensions are required to accommodate the collapsed length of the bellows. Please consult the factory for further information.

Metallic Rod Wipers

Metallic rod wipers replace the standard wiper seal, and are recommended where dust, ice or splashings might damage the wiper seal material. They do not affect cylinder dimensions.

DC Proximity Sensors

These can be fitted to give precise, repeatable end of stroke signals. Please contact the factory for details.

Position Feedback

Linear position transducers of various types are available for 2H series cylinders. Please contact the factory for details.

All dimensions are in millimetres unless otherwise stated.

Mounting Styles and Where to Use Them

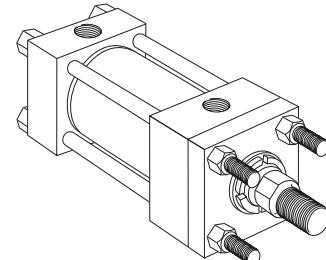
See also application-specific mounting information on page 30.

Extended Tie Rod Mountings – Styles TB, TC and TD**Application**

- straight line force transfer
- compression (push) – use cap end mountings TC or TD
- tension (pull) – use head end mountings TB or TD

Benefits

- ease of mounting where space is limited
- high efficiency – force is absorbed on cylinder's centreline
- TD double-ended mounting allows brackets or switches to be attached to cylinder



TB

Styles TB, TC, TD

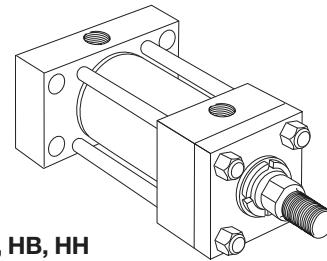
See pages 10-11

Flange Mountings – Styles J, JB, JJ, H, HB and HH**Application**

- straight line force transfer
- compression (push) – use cap end mounting H, HB or HH
- tension (pull) – use head end mounting J, JB or JJ

Benefits

- exceptionally rigid mounting due to large flange area
- high efficiency – force is absorbed on cylinder's centreline



HH

Styles J, JB, JJ, H, HB, HH

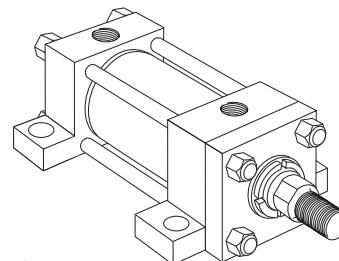
See pages 12-15, 22-23

Foot Mountings – Style C, F, G**Application**

- straight line force transfer
- suitable for push or pull applications
- force is **not** absorbed on centreline – secure attachment, eg: a thrust key (page 30) and effective load guidance are vital

Benefits

- ease of mounting and adjustment



C

Styles C, F, G

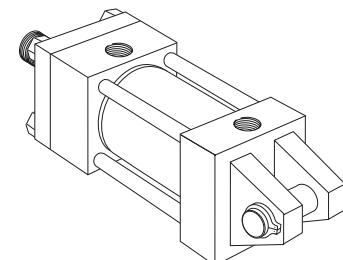
See pages 16-17 and 25

Pivot Mountings – Styles BB and SBa**Application**

- curved path force transfer
- movement in a single plane – use fixed clevis style BB
- movement in more than one plane – use spherical bearing style SBd

Benefits

- ease of attachment – use with plain or spherical bearing at rod end
- greater flexibility for the machine designer
- self-alignment resists wear of cylinder's bearing surfaces



BB

Styles BB, SBa

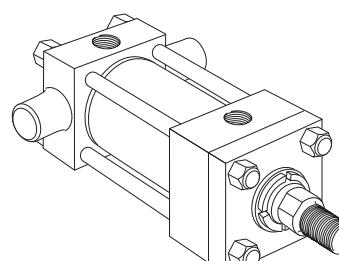
See pages 18-19 and 25

Trunnion Mountings – Styles D, DB and DD**Application**

- curved path force transfer
- movement in a single plane
- compression (push) – use DB or DD mountings
- tension (pull) – use D or DD mountings

Benefits

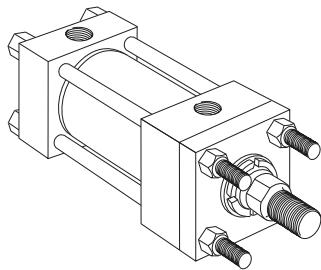
- greater flexibility for the machine designer
- self-alignment resists wear of cylinder's bearing surfaces
- high efficiency – force is absorbed on cylinder's centreline
- ease of attachment – use with pivot mounting at rod end



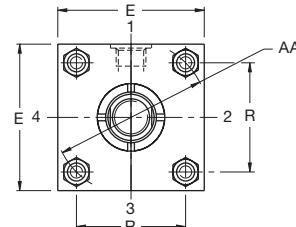
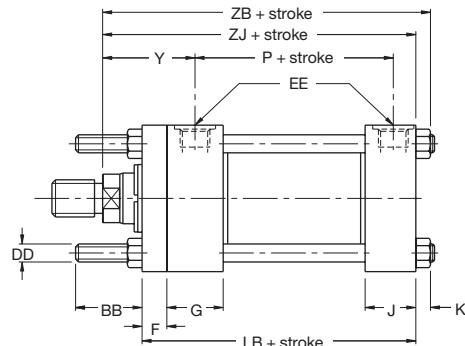
DB

Styles D, DB, DD

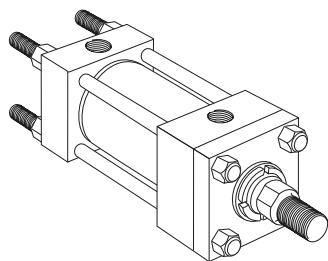
See pages 20-21 and 24



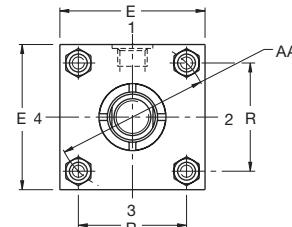
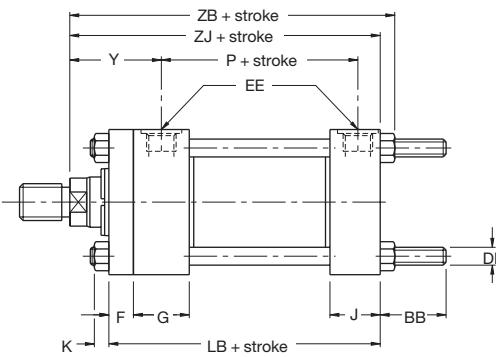
Style TB
Tie Rods Extended Head End
(NFPA Style MX3)



See Notes 1, 2



Style TC
Tie Rods Extended Cap End
(NFPA Style MX2)

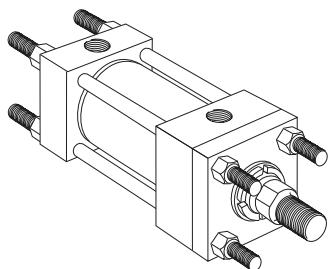


See Notes 1, 2

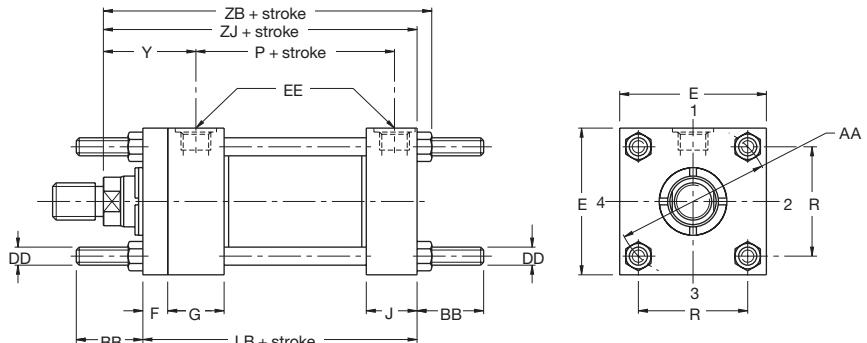
Dimensions TB, TC & TD See also rod end dimensions, page 3 & mounting information, page 30

| Bore Ø | Rod No. | AA | BB | DD ¹ | E | EE (BSPP) | F | G | J |
|------------|------------------|-------|-------|-----------------|-------|-----------|------|------|------|
| 38.1 (1½") | 1 2 | 58.4 | 34.9 | 3/8 - 24 | 63.5 | G½ | 9.5 | 44.5 | 38.1 |
| 50.8 (2") | 1 2 | 73.7 | 46.0 | 1/2 - 20 | 76.2 | G½ | 15.9 | 44.5 | 38.1 |
| 63.5 (2½") | 1 2 3 | 91.4 | 46.0 | 1/2 - 20 | 88.9 | G½ | 15.9 | 44.5 | 38.1 |
| 82.6 (3¼") | 1 2 3 | 116.8 | 58.7 | 5/8 - 18 | 114.3 | G¾ | 19.1 | 50.8 | 44.5 |
| 101.6 (4") | 1 2 3 | 137.2 | 58.7 | 5/8 - 18 | 127.0 | G¾ | 22.2 | 50.8 | 44.5 |
| 127.0 (5") | 1 2 3 4 | 177.8 | 81.0 | 7/8 - 14 | 165.1 | G¾ | 22.2 | 50.8 | 44.5 |
| 152.4 (6") | 1 2 3 4 | 205.7 | 92.1 | 1 - 14 | 190.5 | G1 | 25.4 | 57.2 | 57.2 |
| 177.8 (7") | 1 2 3 4 | 236.2 | 104.8 | 1 1/8 - 12 | 215.9 | G1 1/4 | 25.4 | 69.9 | 69.9 |
| 203.2 (8") | 1 2 3 5 | 269.2 | 114.3 | 1 1/4 - 12 | 241.3 | G1 1/2 | 25.4 | 76.2 | 76.2 |

All dimensions are in millimetres unless otherwise stated.



Style TD

Tie Rods Extended Both Ends
(NFPA Style MX1)

See Notes 1, 2

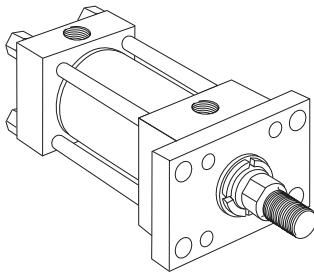
Notes

- 1 All tie rod threads (dimension DD) are UNF, with the exception of 1 - 14 which is UNS
- 2 Mounting nuts should be tightened to the torque values shown for tie rod nuts – see page 30

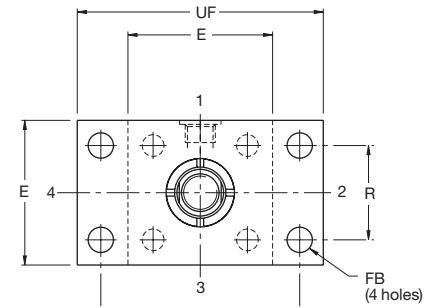
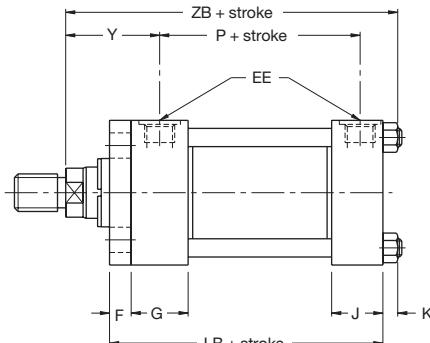
Dimensions TB, TC & TD Continued

| Bore \varnothing | Rod No. | K max | R | Y | + Stroke | | | |
|-----------------------|------------|----------|-------|----|----------|-----|--------|-------|
| | | | | | LB | P | ZB max | ZJ |
| 38.1 (1½") | 1 | 10 | 41.4 | 49 | 127.0 | 75 | 152.4 | 142.9 |
| | 2 | | | 59 | | | 161.9 | 152.4 |
| 50.8 (2") | 1 | | 52.1 | 59 | | | 163.5 | 152.4 |
| | 2 | | | 65 | | | 169.9 | 158.8 |
| 63.5 (2½") | 1 | 13 | 64.8 | 59 | 136.5 | 78 | 166.7 | 156.6 |
| | 2 | | | 71 | | | 179.4 | 168.3 |
| | 3 | | | 65 | | | 173.3 | 161.9 |
| 82.6 (3¼") | 1 | 16 | 82.6 | 68 | 158.8 | 90 | 195.3 | 181.0 |
| | 2 | | | 79 | | | 204.8 | 190.5 |
| | 3 | | | 76 | | | 201.6 | 187.3 |
| 101.6 (4") | 1 | 16 | 97.0 | 76 | 168.3 | 97 | 208.0 | 193.7 |
| | 2 | | | 86 | | | 217.5 | 203.2 |
| | 3 | | | 79 | | | 211.1 | 196.9 |
| 127.0 (5") | 1 | 19 | 125.7 | 79 | 181.0 | 110 | 230.2 | 209.6 |
| | 2 | | | 86 | | | 236.5 | 215.9 |
| | 3 | | | 86 | | | 236.5 | 215.9 |
| | 4 | | | 86 | | | 236.5 | 215.9 |
| 152.4 (6") | 1 | 23 | 145.5 | 86 | 212.7 | 130 | 266.7 | 244.5 |
| | 2 | | | 86 | | | | |
| | 3 | | | 86 | | | | |
| | 4 | | | 86 | | | | |
| 177.8 (7") | 1 | 26 | 167.1 | 92 | 241.3 | 146 | 298.5 | 273.0 |
| | 2 | | | 92 | | | | |
| | 3 | | | 92 | | | | |
| | 4 | | | 92 | | | | |
| 203.2 (8") | 1 | 28 | 190.5 | 94 | 266.7 | 168 | 325.4 | 298.4 |
| | 2 | | | 94 | | | | |
| | 3 | | | 94 | | | | |
| | 4 | | | 94 | | | | |
| | 5 | | | 94 | | | | |

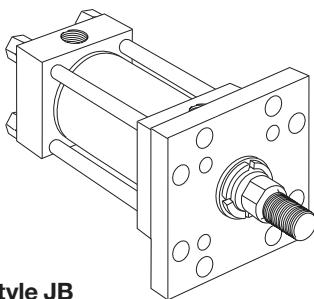
All dimensions are in millimetres unless otherwise stated.



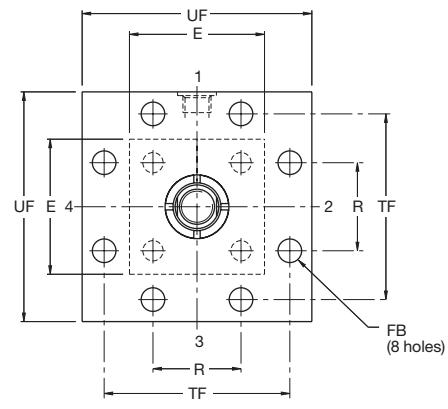
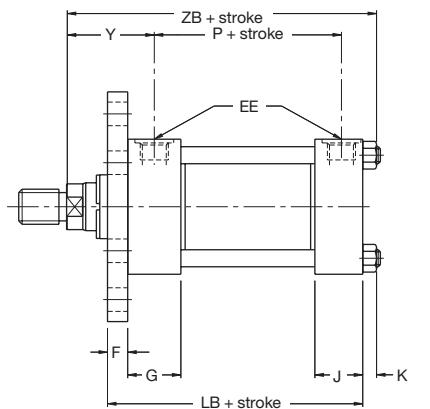
Style J
Head Rectangular Flange
(NFPA Style MF1)



See Note 1



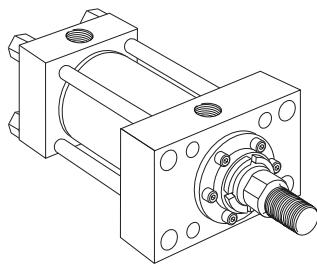
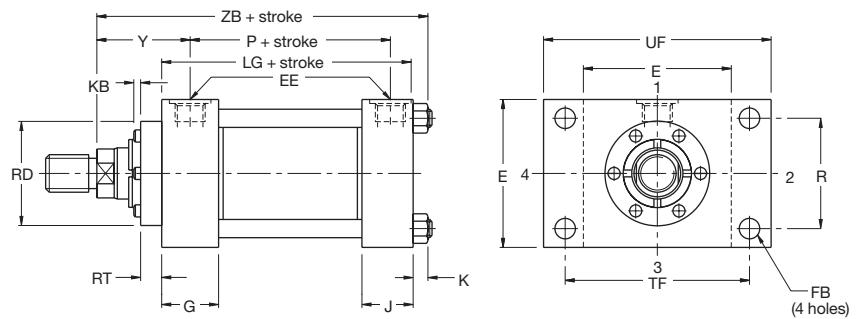
Style JB
Head Square Flange
(NFPA Style MF5)



Dimensions J, JB & JJ See also rod end dimensions, page 3 & mounting information, page 30

| Bore Ø | Rod No. | E | EE (BSPP) | F | FB | G | J | K | KB | R |
|------------|------------------|-------|-----------|------|------|------|------|----|--------------------------|-------|
| 38.1 (1½") | 1 2 | 63.5 | G½ | 9.5 | 11.1 | 44.5 | 38.1 | 10 | 0.0 | 41.4 |
| 50.8 (2") | 1 2 | 76.2 | G½ | 15.9 | 14.3 | 44.5 | 38.1 | 13 | 0.0 6.4 | 52.1 |
| 63.5 (2½") | 1 2 3 | 88.9 | G½ | 15.9 | 14.3 | 44.5 | 38.1 | 13 | 0.0 6.4 6.4 | 64.8 |
| 82.6 (3¼") | 1 2 3 | 114.3 | G¾ | 19.1 | 17.5 | 50.8 | 44.5 | 16 | 6.4 3.2 6.4 | 82.6 |
| 101.6 (4") | 1 2 3 | 127.0 | G¾ | 22.2 | 17.5 | 50.8 | 44.5 | 16 | 6.4 6.4 3.2 | 97.0 |
| 127.0 (5") | 1 2 3 4 | 165.1 | G¾ | 22.2 | 23.8 | 50.8 | 44.5 | 19 | 3.2 6.4 6.4 6.4 | 125.7 |
| 152.4 (6") | 1 2 3 4 | 190.5 | G1 | 25.4 | 27.0 | 57.2 | 57.2 | 22 | 6.4 6.4 6.4 6.4 | 145.5 |
| 177.8 (7") | 1 2 3 4 | 215.9 | G1¼ | 25.4 | 30.2 | 69.9 | 69.9 | 24 | 6.4 0.0 6.4 6.4 | 167.1 |
| 203.2 (8") | 1 2 3 5 | 241.3 | G1½ | 25.4 | 33.3 | 76.2 | 76.2 | 27 | 6.4 6.4 6.4 0.0 | 190.5 |

All dimensions are in millimetres unless otherwise stated.

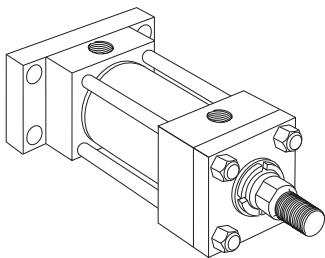
**Style JJ**Rectangular Head
(NFPA Style ME5)**Notes**

- 1 For maximum pressure ratings in push applications, see page 32

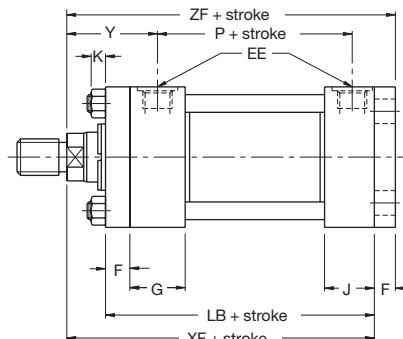
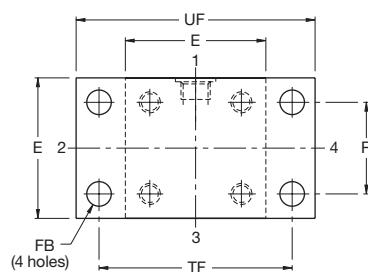
Dimensions J, JB & JJ Continued

| Bore Ø | Rod No. | RD max | RT | TF | UF | Y | + Stroke | | | |
|---------------|------------|-----------|------|-------|-------|----|----------|-------|-----|--------|
| | | | | | | | LB | LG | P | ZB max |
| 38.1 (1½") | 1 | 54.0 | 9.5 | 87.3 | 108.0 | 49 | 127.0 | 117.5 | 75 | 152.4 |
| | 2 | 63.5 | 9.5 | | | 59 | | | | 161.9 |
| 50.8 (2") | 1 | 63.5 | 9.5 | 104.8 | 130.2 | 59 | 133.4 | 117.5 | 75 | 163.5 |
| | 2 | 76.2 | 9.5 | | | 65 | | | | 169.9 |
| 63.5 (2½") | 1 | 63.5 | 9.5 | 117.5 | 142.9 | 59 | 136.5 | 120.7 | 78 | 166.7 |
| | 2 | 88.9 | 9.5 | | | 71 | | | | 179.4 |
| | 3 | 76.2 | 9.5 | | | 65 | | | | 173.3 |
| 82.6 (3¼") | 1 | 76.2 | 9.5 | 149.2 | 181.0 | 68 | 158.8 | 139.7 | 90 | 195.3 |
| | 2 | 101.6 | 15.9 | | | 79 | | | | 204.8 |
| | 3 | 88.9 | 9.5 | | | 76 | | | | 201.6 |
| 101.6 (4") | 1 | 88.9 | 9.5 | 161.9 | 193.7 | 76 | 168.3 | 146.1 | 97 | 208.0 |
| | 2 | 114.3 | 15.9 | | | 86 | | | | 217.5 |
| | 3 | 101.6 | 15.9 | | | 79 | | | | 211.1 |
| 127.0 (5") | 1 | 101.6 | 15.9 | 208.0 | 247.7 | 79 | 181.0 | 158.8 | 110 | 230.2 |
| | 2 | 146.1 | 15.9 | | | 86 | | | | 236.5 |
| | 3 | 114.3 | 15.9 | | | 86 | | | | 236.5 |
| | 4 | 133.4 | 15.9 | | | 86 | | | | 236.5 |
| 152.4 (6") | 1 | 114.3 | 15.9 | 239.7 | 285.8 | 86 | 212.7 | 187.3 | 130 | 266.7 |
| | 2 | 165.1 | 19.1 | | | 86 | | | | |
| | 3 | 133.4 | 15.9 | | | 86 | | | | |
| | 4 | 146.1 | 15.9 | | | 86 | | | | |
| 177.8 (7") | 1 | 133.4 | 15.9 | 269.9 | 320.7 | 92 | 241.3 | 215.9 | 146 | 298.5 |
| | 2 | 190.5 | 25.4 | | | 92 | | | | |
| | 3 | 146.1 | 15.9 | | | 92 | | | | |
| | 4 | 165.1 | 19.1 | | | 92 | | | | |
| 203.2 (8") | 1 | 146.1 | 15.9 | 300.0 | 355.6 | 94 | 266.7 | 241.3 | 168 | 325.4 |
| | 2 | 209.6 | 19.1 | | | 94 | | | | |
| | 3 | 165.1 | 19.1 | | | 94 | | | | |
| | 4 | 190.5 | 25.4 | | | 94 | | | | |

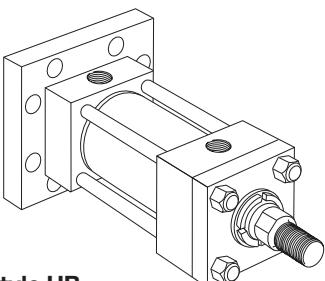
All dimensions are in millimetres unless otherwise stated.



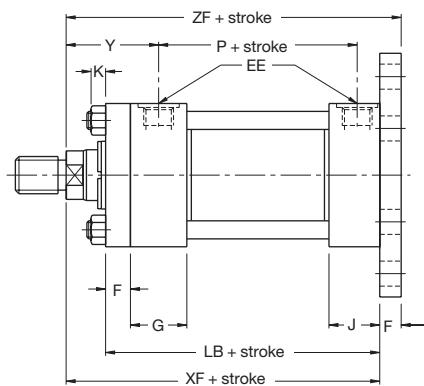
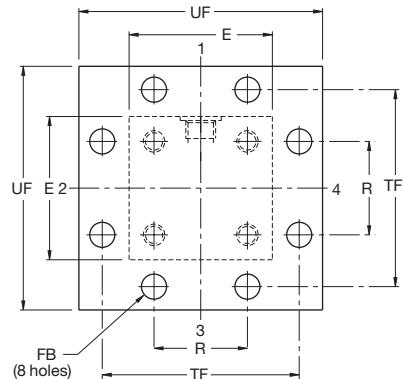
Style H
Cap Rectangular Flange
(NFPA Style MF2)



See Note 1



Style HB
Cap Square Flange
(NFPA Style MF6)

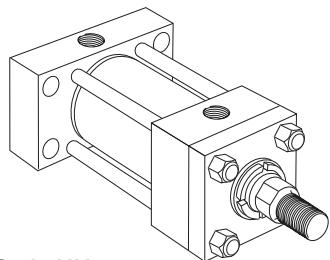


Dimensions H, HB & HH See also rod end dimensions, page 3 & mounting information, page 30

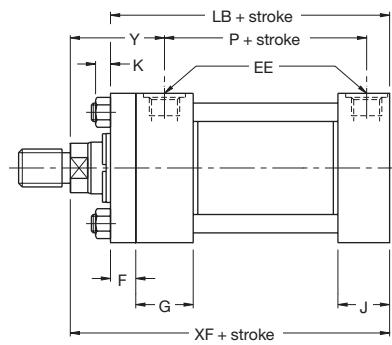
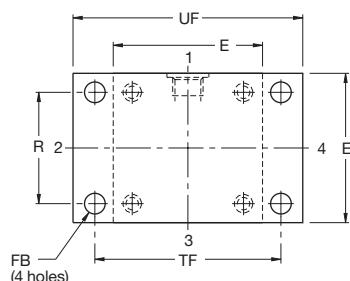
| Bore Ø | Rod No. |
|------------|------------------|
| 38.1 (1½") | 1 2 |
| 50.8 (2") | 1 2 |
| 63.5 (2½") | 1 2 3 |
| 82.6 (3¼") | 1 2 3 |
| 101.6 (4") | 1 2 3 |
| 127.0 (5") | 1 2 3 4 |
| 152.4 (6") | 1 2 3 4 |
| 177.8 (7") | 1 2 3 4 |
| 203.2 (8") | 1 2 3 5 |

| E | EE (BSP) | F | FB | G | J | K | R |
|-------|-------------------------------|------|------|------|------|----|-------|
| 63.5 | G ¹ / ₂ | 9.5 | 11.1 | 44.5 | 38.1 | 10 | 41.4 |
| 76.2 | G ¹ / ₂ | 15.9 | 14.3 | 44.5 | 38.1 | 13 | 52.1 |
| 88.9 | G ¹ / ₂ | 15.9 | 14.3 | 44.5 | 38.1 | 13 | 64.8 |
| 114.3 | G ³ / ₄ | 19.1 | 17.5 | 50.8 | 44.5 | 16 | 82.6 |
| 127.0 | G ³ / ₄ | 22.2 | 17.5 | 50.8 | 44.5 | 16 | 97.0 |
| 165.1 | G ³ / ₄ | 22.2 | 23.8 | 50.8 | 44.5 | 19 | 125.7 |
| 190.5 | G1 | 25.4 | 27.0 | 57.2 | 57.2 | 22 | 145.5 |
| 215.9 | G1¼ | 25.4 | 30.2 | 69.9 | 69.9 | 24 | 167.1 |
| 241.3 | G1½ | 25.4 | 33.3 | 76.2 | 76.2 | 27 | 190.5 |

All dimensions are in millimetres unless otherwise stated.



Style HH
Rectangular Cap
(NFPA Style ME6)



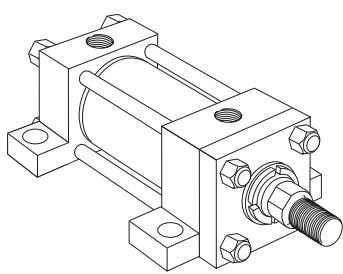
Notes

1 For maximum pressure ratings in pull applications, see page 36

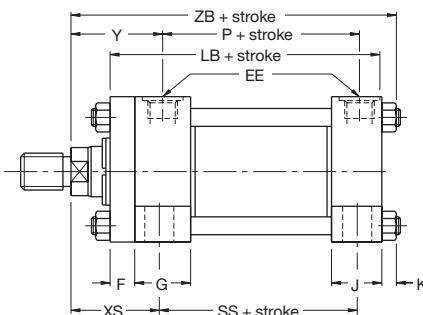
Dimensions H, HB & HH Continued

| Bore Ø | Rod No. | TF | UF | Y | + Stroke | | | |
|---------------|---------|-------|-------|----------------------|----------|-----|----------------------------------|----------------------------------|
| | | | | | LB | P | XF | ZF |
| 38.1 (1½") | 1 | 87.3 | 108.0 | 49 59 | 127.0 | 75 | 142.9 152.4 | 152.4 161.9 |
| | 2 | | | | | | | |
| 50.8 (2") | 1 | 104.8 | 130.2 | 59 65 | 133.4 | 75 | 152.4 158.8 | 168.3 174.6 |
| | 2 | | | | | | | |
| 63.5 (2½") | 1 | 117.5 | 142.9 | 59 71 65 | 136.5 | 78 | 156.6 168.3 161.9 | 171.5 184.2 177.8 |
| | 2 | | | | | | | |
| | 3 | | | | | | | |
| 82.6 (3¼") | 1 | 149.2 | 181.0 | 68 79 76 | 158.8 | 90 | 181.0 190.5 187.3 | 200.0 209.6 206.4 |
| | 2 | | | | | | | |
| | 3 | | | | | | | |
| 101.6 (4") | 1 | 161.9 | 193.7 | 76 86 79 | 168.3 | 97 | 193.7 203.2 196.9 | 215.9 225.4 219.1 |
| | 2 | | | | | | | |
| | 3 | | | | | | | |
| 127.0 (5") | 1 | 208.0 | 247.7 | 79 86 86 86 | 181.0 | 110 | 209.6 215.9 215.9 215.9 | 231.8 238.1 238.1 238.1 |
| | 2 | | | | | | | |
| | 3 | | | | | | | |
| | 4 | | | | | | | |
| 152.4 (6") | 1 | 239.7 | 285.8 | 86 | 212.7 | 130 | 244.5 | 269.9 |
| | 2 | | | | | | | |
| | 3 | | | | | | | |
| | 4 | | | | | | | |
| 177.8 (7") | 1 | 269.9 | 320.7 | 92 | 241.3 | 146 | 273.0 | 298.5 |
| | 2 | | | | | | | |
| | 3 | | | | | | | |
| | 4 | | | | | | | |
| 203.2 (8") | 1 | 300.0 | 355.6 | 94 | 266.7 | 168 | 298.5 | 323.9 |
| | 2 | | | | | | | |
| | 3 | | | | | | | |
| | 4 | | | | | | | |
| | 5 | | | | | | | |

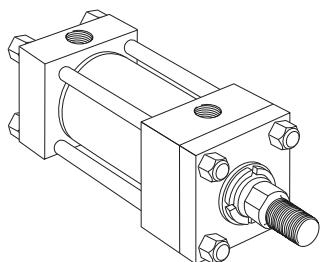
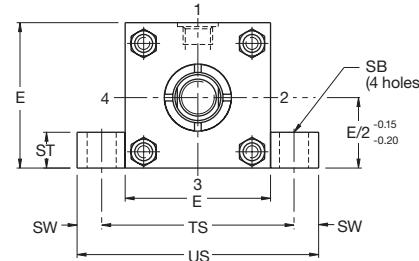
All dimensions are in millimetres unless otherwise stated.



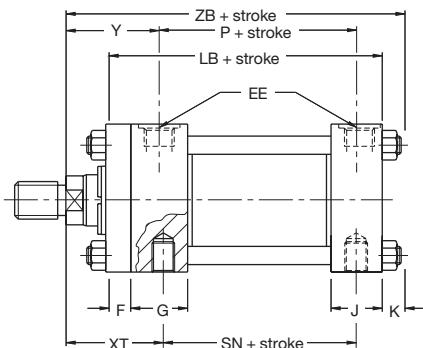
Style C
Side Lug Mounting
(NFPA Style MS2)



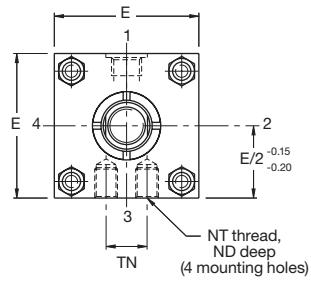
See Notes 1, 3, 4



Style F
Side Tapped Mounting
(NFPA Style MS4)



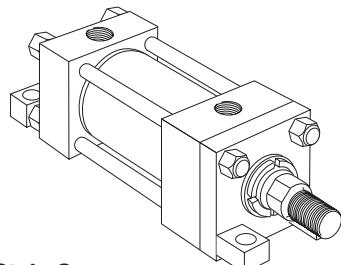
See Notes 1, 2



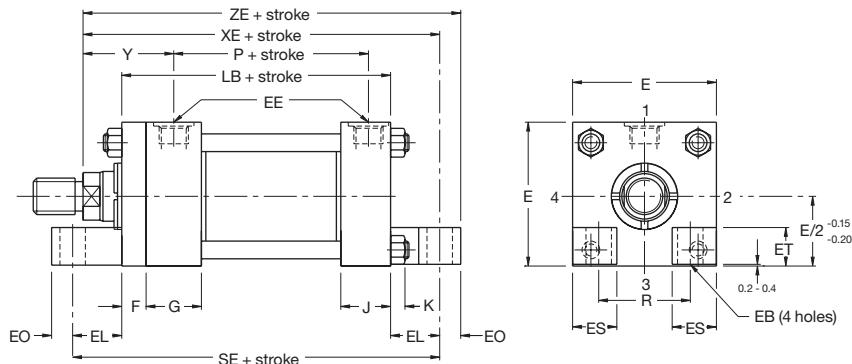
Dimensions C, F & G See also rod end dimensions, page 3 & mounting information, page 30

| Bore Ø | Rod No. | E | EB | EE (BSPP) | EL | EO | ES | ET | F | G | J | K | ND | NT ² | R | SB ³ | ST |
|------------|------------------|-------|------|-----------|------|------|----|----|------|------|------|----|----------------------|-----------------|-------|-----------------|------|
| 38.1 (1½") | 1 2 | 63.5 | 11.5 | G½ | 22.2 | 9.5 | 24 | 21 | 9.5 | 44.5 | 38.1 | 10 | 12 12 | M10 | 41.4 | 11 | 12.7 |
| 50.8 (2") | 1 2 | 76.2 | 14.3 | G½ | 23.8 | 12.7 | 24 | 24 | 15.9 | 44.5 | 38.1 | 13 | 15 11 | M12 | 52.1 | 14 | 19.1 |
| 63.5 (2½") | 1 2 3 | 88.9 | 14.3 | G½ | 23.8 | 12.7 | 24 | 24 | 15.9 | 44.5 | 38.1 | 13 | 14 12 14 | M16 | 64.8 | 22 | 25.4 |
| 82.6 (3¼") | 1 2 3 | 114.3 | 17.5 | G¾ | 28.6 | 15.9 | 32 | 31 | 19.1 | 50.8 | 44.5 | 16 | 22 17 22 | M20 | 82.6 | 22 | 25.4 |
| 101.6 (4") | 1 2 3 | 127.0 | 17.5 | G¾ | 28.6 | 15.9 | 32 | 29 | 22.2 | 50.8 | 44.5 | 16 | 25 17 25 | M24 | 97.0 | 26 | 31.8 |
| 127.0 (5") | 1 2 3 4 | 165.1 | 23.8 | G¾ | 38.1 | 19.1 | 38 | 38 | 22.2 | 50.8 | 44.5 | 19 | 28 25 28 28 | M24 | 125.7 | 26 | 31.8 |
| 152.4 (6") | 1 2 3 4 | 190.5 | 27.0 | G1 | 42.9 | 22.2 | 45 | 45 | 25.4 | 57.2 | 57.2 | 22 | 44 31 44 38 | M30 | 145.5 | 33 | 38.1 |
| 177.8 (7") | 1 2 3 4 | 215.9 | 30.2 | G1¼ | 46.0 | 25.4 | 50 | 48 | 25.4 | 69.9 | 69.9 | 24 | 54 28 54 44 | M42 | 167.1 | 39 | 44.5 |
| 203.2 (8") | 1 2 3 5 | 241.3 | 33.3 | G1½ | 50.8 | 28.6 | 50 | 48 | 25.4 | 76.2 | 76.2 | 27 | 57 38 57 44 | M42 | 190.5 | 39 | 44.5 |

All dimensions are in millimetres unless otherwise stated.



Style G
Side End Lug
(NFPA Style MS7)



See Note 1

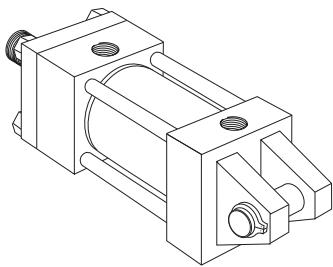
Notes

- 1 Consider the use of a thrust key with this mounting – see page 30
- 2 Tapped mounting holes are metric (coarse pitch series)
- 3 Upper surfaces of lugs are machined for socket head screws
- 4 Style C cylinders can be supplied with the cylinder ports arranged for mounting and sealing to a manifold surface – see page 31

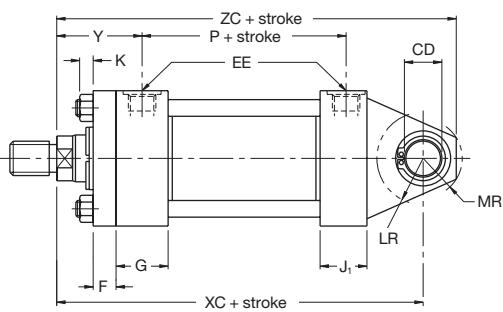
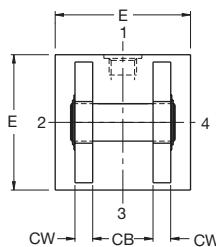
Dimensions C, F & G Continued

| Bore Ø | Rod No. | + Stroke | | | | | | | | | | | | | | |
|------------|---------|----------|-------|-------|-------|------------------------------|----------------------------|----------------------|-------|-----|-------|-------|-------|----------------------------------|----------------------------------|----------------------------------|
| | | SW | TN | TS | US | XS | XT | Y | LB | P | SE | SN | SS | XE | ZB max | ZE |
| 38.1 (1½") | 1 | 9.5 | 18.0 | 82.6 | 101.6 | 34.9 44.5 | 50.8 60.3 | 49 59 | 127.0 | 75 | 171.5 | 73.0 | 98.4 | 165.1 174.6 | 152.4 161.9 | 174.6 184.2 |
| 50.8 (2") | 1 | 12.7 | 23.8 | 101.6 | 127.0 | 47.6 54.0 | 60.3 66.7 | 59 65 | 133.4 | 75 | 181.0 | 73.0 | 92.1 | 176.2 182.6 | 163.5 169.9 | 188.9 195.3 |
| 63.5 (2½") | 1 | 17.5 | 32.0 | 123.8 | 158.8 | 52.4 65.1 58.7 | 60.3 73.0 66.7 | 59 71 65 | 136.5 | 78 | 184.2 | 76.2 | 85.7 | 179.4 192.1 185.7 | 166.7 179.4 173.3 | 192.1 204.8 198.4 |
| 82.6 (3¼") | 1 | 17.5 | 38.1 | 149.2 | 184.2 | 58.7 68.3 65.1 | 69.9 79.4 76.2 | 68 79 76 | 158.8 | 90 | 215.9 | 88.9 | 104.8 | 209.6 219.1 215.9 | 195.3 204.8 210.6 | 225.4 235.0 231.8 |
| 101.6 (4") | 1 | 22.2 | 52.4 | 171.5 | 215.9 | 69.9 79.4 73.0 | 76.2 85.7 79.4 | 76 86 79 | 168.3 | 97 | 225.4 | 95.3 | 101.6 | 222.3 231.8 225.4 | 208.0 217.5 211.1 | 238.1 247.7 241.3 |
| 127.0 (5") | 1 | 22.2 | 74.6 | 209.6 | 254.0 | 73.0 79.4 79.4 79.4 | 79.4 85.7 86 85.7 | 79 86 86 86 | 181.0 | 110 | 257.2 | 108.0 | 114.3 | 247.7 254.0 254.0 254.0 | 230.2 236.5 236.5 236.5 | 266.7 273.1 273.1 273.1 |
| 152.4 (6") | 1 | 28.6 | 84.1 | 247.7 | 304.8 | 85.7 | 88.9 | 86 | 212.7 | 130 | 298.5 | 130.2 | 130.2 | 287.3 | 266.7 | 309.6 |
| 177.8 (7") | 1 | 34.9 | 90.0 | 285.8 | 355.6 | 92.1 | 96.8 | 92 | 241.3 | 146 | 333.4 | 149.2 | 146.1 | 319.1 | 298.5 | 344.5 |
| 203.2 (8") | 1 | 34.9 | 105.0 | 311.2 | 381.0 | 92.1 | 100.0 | 94 | 266.7 | 168 | 368.3 | 168.3 | 171.5 | 349.3 | 325.4 | 377.8 |

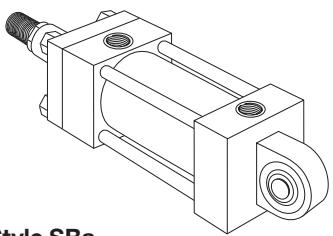
All dimensions are in millimetres unless otherwise stated.



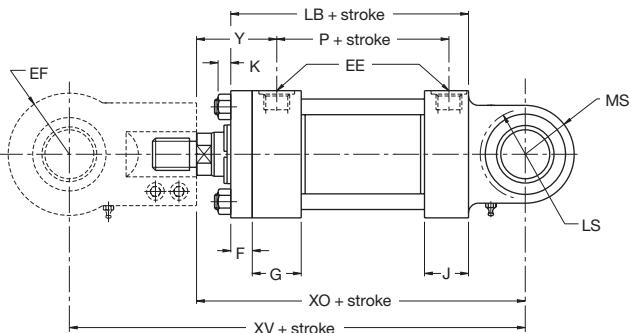
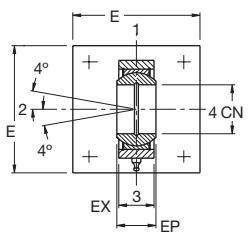
Style BB

Cap Fixed Clevis
(NFPA Style MP1)

See Note 1



Style SBa

Spherical Bearing
(ISO 6982 and CETOP RP88H)

See Notes 2, 3, 4, 5

Dimensions BB & SBa See also rod end dimensions, page 3 & mounting information, page 30

| Bore Ø | Rod No. | |
|------------|---------|--|
| 38.1 (1½") | 1 | |
| | 2 | |
| 50.8 (2") | 1 | |
| | 2 | |
| 63.5 (2½") | 1 | |
| | 2 | |
| | 3 | |
| 82.6 (3¼") | 1 | |
| | 2 | |
| | 3 | |
| 101.6 (4") | 1 | |
| | 2 | |
| | 3 | |
| 127.0 (5") | 1 | |
| | 2 | |
| | 3 | |
| | 4 | |
| 152.4 (6") | 1 | |
| | 2 | |
| | 3 | |
| | 4 | |
| 177.8 (7") | 1 | |
| | 2 | |
| | 3 | |
| | 4 | |
| 203.2 (8") | 1 | |
| | 2 | |
| | 3 | |
| | 5 | |

| CB | CD +0.00 -0.05 | CN H7 | CW | E | EE (BSPP) | EF max | EP | EX | F | G | J | J ₁ |
|------|----------------|-------|------|-------|--------------------------------|--------|----|----|------|------|------|----------------|
| 19.8 | 12.73 | 20 | 12.7 | 63.5 | G ¹ / ₂ | 25 | 20 | 18 | 9.5 | 44.5 | 38.1 | 42 |
| 32.5 | 19.08 | 25 | 15.9 | 76.2 | G ¹ / ₂ | 31 | 25 | 22 | 15.9 | 44.5 | 38.1 | 42 |
| 32.5 | 19.08 | 32 | 15.9 | 88.9 | G ¹ / ₂ | 38 | 32 | 28 | 15.9 | 44.5 | 38.1 | 42 |
| 38.9 | 25.43 | 40 | 19.1 | 114.3 | G ³ / ₄ | 49 | 40 | 35 | 19.1 | 50.8 | 44.5 | 50 |
| 51.6 | 34.95 | 50 | 25.4 | 127.0 | G ³ / ₄ | 59 | 50 | 40 | 22.2 | 50.8 | 44.5 | 50 |
| 65.0 | 44.48 | 63 | 31.8 | 165.1 | G ³ / ₄ | 71 | 63 | 52 | 22.2 | 50.8 | 44.5 | 50 |
| 65.0 | 50.83 | 80 | 31.8 | 190.5 | G1 | 90 | 80 | 60 | 25.4 | 57.2 | 57.2 | 61 |
| | | | | | | | | | | | | |
| 77.8 | 63.53 | — | 38.1 | 215.9 | G1 ¹ / ₄ | — | — | — | 25.4 | 69.9 | 69.9 | 74 |
| | | | | | | | | | | | | |
| 77.8 | 76.23 | — | 38.1 | 241.3 | G1 ¹ / ₂ | — | — | — | 25.4 | 76.2 | 76.2 | 78 |

All dimensions are in millimetres unless otherwise stated.

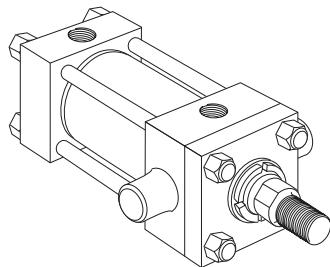
Notes

- 1 Supplied complete with pivot pin
- 2 Maximum pressure rating 160 bar
- 3 For matching pin sizes specify rod end Style 7, see pages 3 and 29
- 4 Pivot pin not supplied
- 5 For spherical bearing mountings on cylinders above 152.4mm (6") bore, please consult the factory

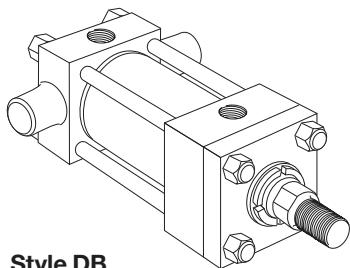
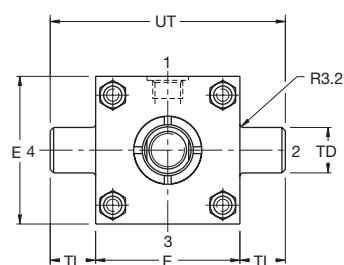
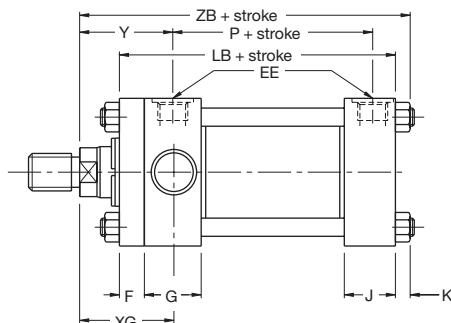
Dimensions BB & SBa Continued

| Bore Ø | Rod No. | K | LR | LS | MR | MS max | Y | + Stroke | | | | | |
|-----------------------------|------------------|----|------|----|------|-----------|----------------------|----------|-----|----------------------------------|--------------------------|--------------------------|----------------------------------|
| | | | | | | | | LB | P | XC | XO ⁵ | XV | ZC |
| 38.1 (1 $\frac{1}{2}$ ') | 1 2 | 10 | 14.3 | 23 | 15.9 | 25 | 49 59 | 127.0 | 75 | 161.9 171.5 | — 182.5 | — 234.5 | 177.8 187.4 |
| 50.8 (2") | 1 2 | 13 | 25.4 | 26 | 23.8 | 31 | 59 65 | 133.4 | 75 | 184.2 190.5 | 182.5 188.8 | 247.5 253.8 | 208.0 214.3 |
| 63.5 (2 $\frac{1}{2}$ ') | 1 2 3 | 13 | 23.8 | 32 | 23.8 | 38 | 59 71 65 | 136.5 | 78 | 187.3 200.0 193.7 | — 217.2 210.8 | — 297.2 290.8 | 211.1 223.8 217.5 |
| 82.6 (3 $\frac{1}{4}$ ') | 1 2 3 | 16 | 31.8 | 41 | 30.2 | 50 | 68 79 76 | 158.8 | 90 | 219.1 228.6 225.4 | — 240.6 237.4 | — 337.6 334.4 | 249.3 258.8 255.6 |
| 101.6 (4") | 1 2 3 | 16 | 44.5 | 50 | 41.3 | 61 | 76 86 79 | 168.3 | 97 | 247.7 257.2 250.8 | — 266.2 259.9 | — 386.2 379.9 | 289.0 298.4 292.1 |
| 127.0 (5") | 1 2 3 4 | 19 | 52.4 | 62 | 54.0 | 71 | 79 86 86 86 | 181.0 | 110 | 266.7 273.1 273.1 273.1 | — 282.9 282.9 — | — 422.9 422.9 — | 320.7 327.1 327.1 327.1 |
| 152.4 (6") | 1 2 3 4 | 22 | 58.7 | 78 | 60.3 | 93 | 86 | 212.7 | 130 | 308.0 | — 358.3 — 358.3 | — 538.3 — 538.3 | 368.3 |
| 177.8 (7") | 1 2 3 4 | 24 | 69.9 | — | 73.0 | — | 92 | 241.3 | 146 | 349.3 | — | — | 422.3 |
| 203.2 (8") | 1 2 3 5 | 27 | 82.6 | — | 79.4 | — | 94 | 266.7 | 168 | 381.0 | — | — | 460.4 |

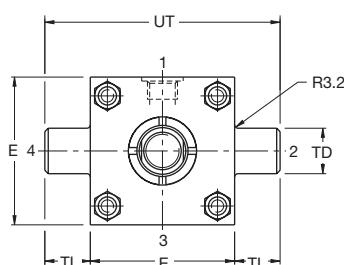
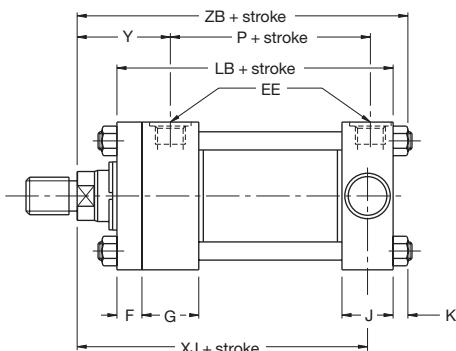
All dimensions are in millimetres unless otherwise stated.



Style D
Head Trunnion
(NFPA Style MT1)



Style DB
Cap Trunnion
(NFPA Style MT2)

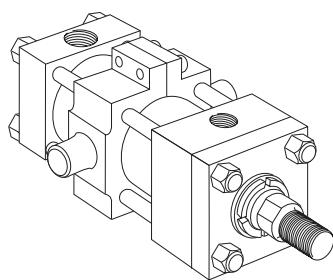


Dimensions D, DB & DD See also rod end dimensions, page 3 & mounting information, page 30

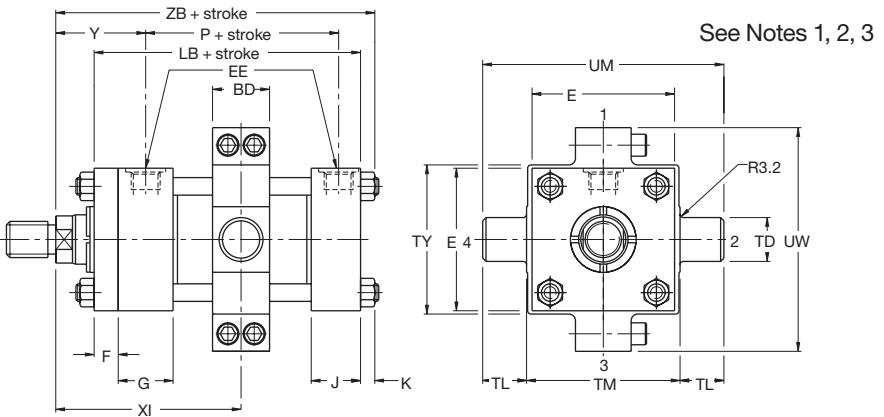
| Bore Ø | Rod No. |
|------------|------------------|
| 38.1 (1½") | 1 2 |
| 50.8 (2") | 1 2 |
| 63.5 (2½") | 1 2 3 |
| 82.6 (3¼") | 1 2 3 |
| 101.6 (4") | 1 2 3 |
| 127.0 (5") | 1 2 3 4 |
| 152.4 (6") | 1 2 3 4 |
| 177.8 (7") | 1 2 3 4 |
| 203.2 (8") | 1 2 3 5 |

| BD | E | EE (BSPP) | F | G | J | K | TD ^{+0.00} _{-0.03} | TL | TM | TY |
|------|-------|--------------------------------|------|------|------|----|---|------|-------|-------|
| 31.8 | 63.5 | G ¹ / ₂ | 9.5 | 44.5 | 38.1 | 10 | 25.40 | 25.4 | 76.2 | 69.9 |
| 38.1 | 76.2 | G ¹ / ₂ | 15.9 | 44.5 | 38.1 | 13 | 34.93 | 34.9 | 88.9 | 82.6 |
| 38.1 | 88.9 | G ¹ / ₂ | 15.9 | 44.5 | 38.1 | 13 | 34.93 | 34.9 | 101.6 | 95.2 |
| 50.8 | 114.3 | G ³ / ₄ | 19.1 | 50.8 | 44.5 | 16 | 44.45 | 44.5 | 127.0 | 120.7 |
| 50.8 | 127.0 | G ³ / ₄ | 22.2 | 50.8 | 44.5 | 16 | 44.45 | 44.5 | 139.7 | 133.4 |
| 50.8 | 165.1 | G ³ / ₄ | 22.2 | 50.8 | 44.5 | 19 | 44.45 | 44.5 | 177.8 | 171.5 |
| 76.2 | 190.5 | G1 | 25.4 | 57.2 | 57.2 | 22 | 50.8 | 50.8 | 215.9 | 196.9 |
| 76.2 | 215.9 | G1 ¹ / ₄ | 25.4 | 69.9 | 69.9 | 24 | 63.5 | 63.5 | 247.7 | 222.3 |
| 88.9 | 241.3 | G1 ¹ / ₂ | 25.4 | 76.2 | 76.2 | 27 | 76.2 | 76.2 | 279.4 | 247.7 |

All dimensions are in millimetres unless otherwise stated.



Style DD

Intermediate Fixed Trunnion
(NFPA Style MT4)**Notes**

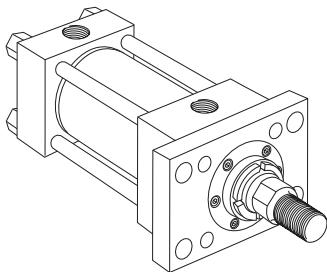
- 1 Note the minimum strokes from the table below
- 2 XI dimension to be specified by customer, note minimum dimension
- 3 A one-piece trunnion is fitted to 38.1mm (1½"), 50.8mm (2") and 63.5mm (2½") bore cylinders

Dimensions D, DB & DD Continued

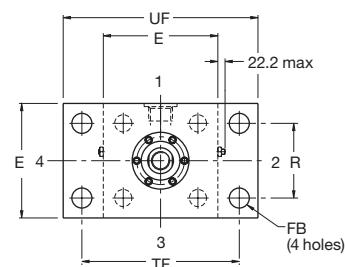
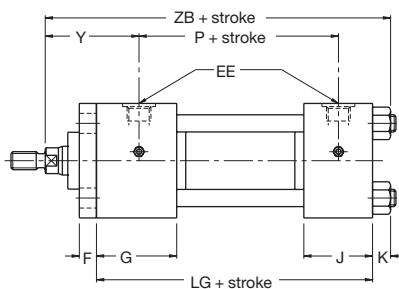
| Bore Ø | Rod No. | 1 | 2 | 3 | 4 |
|------------|---------|---|---|---|---|
| 38.1 (1½") | 1 | | | | |
| | 2 | | | | |
| 50.8 (2") | 1 | | | | |
| | 2 | | | | |
| 63.5 (2½") | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| 82.6 (3¼") | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| 101.6 (4") | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| 127.0 (5") | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |
| 152.4 (6") | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |
| 177.8 (7") | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |
| 203.2 (8") | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | 5 | | | | |

| UM | UT | UW ³ | XG | Min. ² XI | Y | Style DD min stroke | + Stroke | | | |
|-------|-------|-----------------|------------------------------|----------------------------------|----------------------|---------------------|----------|-----|----------------------------------|----------------------------------|
| | | | | | | | LB | P | XJ | ZB max |
| 127.0 | 114.3 | – | 47.6 57.2 | 85.7 95.3 | 49 59 | 0.0 | 127.0 | 75 | 123.8 133.4 | 152.4 161.9 |
| 158.8 | 146.1 | – | 57.2 63.5 | 98.4 104.8 | 59 65 | 3.2 | 133.4 | 75 | 133.4 139.7 | 163.5 169.9 |
| 171.5 | 158.8 | – | 57.2 69.9 63.5 | 98.4 111.1 104.8 | 59 71 65 | 0.0 | 136.5 | 78 | 136.5 149.2 142.9 | 166.7 179.4 173.3 |
| 215.9 | 203.2 | 171.5 | 66.7 76.2 73.0 | 117.5 127.0 123.8 | 68 79 76 | 6.4 | 158.8 | 90 | 158.8 168.3 165.1 | 195.3 204.8 201.6 |
| 228.6 | 215.9 | 184.2 | 73.0 82.6 76.2 | 123.8 133.4 127.0 | 76 86 79 | 0.0 | 168.3 | 97 | 171.5 181.0 174.6 | 208.0 217.5 211.1 |
| 266.7 | 254.0 | 228.6 | 76.2 82.6 82.6 82.6 | 127.0 133.4 133.4 133.4 | 79 86 86 86 | 0.0 | 181.0 | 110 | 187.3 193.7 193.7 193.7 | 230.2 236.5 236.5 236.5 |
| 317.5 | 292.1 | 260.4 | 85.7 | 152.4 | 86 | 3.2 | 212.7 | 130 | 212.7 | 266.7 |
| 374.7 | 342.9 | 292.1 | 92.1 | 165.1 | 92 | 0.0 | 241.3 | 146 | 238.1 | 298.5 |
| 431.8 | 393.7 | 323.9 | 95.3 | 177.8 | 94 | 0.0 | 266.7 | 168 | 260.4 | 325.4 |

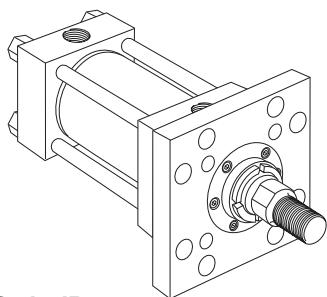
All dimensions are in millimetres unless otherwise stated.



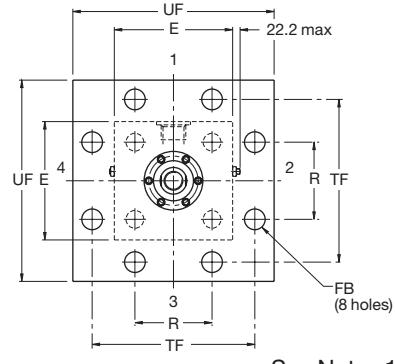
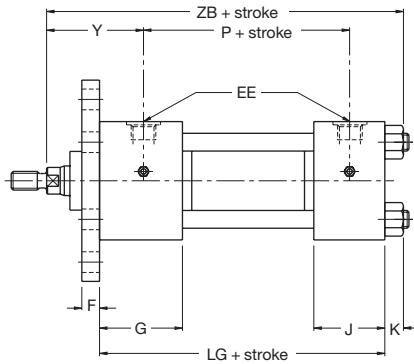
Style J

Head Rectangular Flange
(NFPA Style MF1)

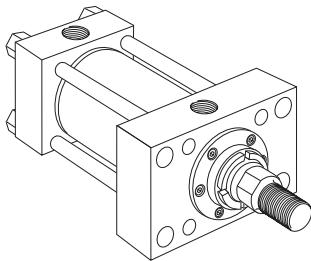
See Notes 1, 2, 3, 4



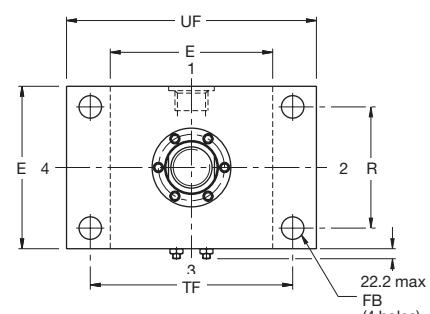
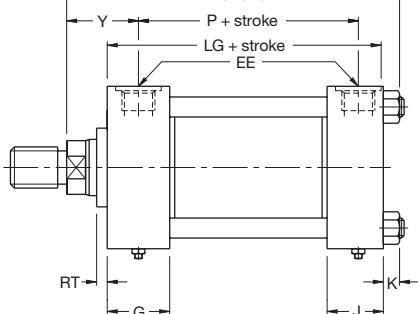
Style JB

Head Square Flange
(NFPA Style MF5)

See Notes 1, 2, 4



Style JJ

Rectangular Head
(NFPA Style ME5)

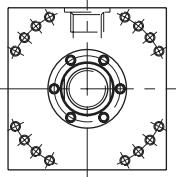
See Notes 1, 2, 4

Dimensions J, JB & JJ See also rod end dimensions, page 40 & mounting information, page 30

| Bore Ø | Rod No. | + Stroke | | | | | | | | | | | | | | |
|-------------|---------|----------|------------------------|------|------|-------|-------|------------|-------|--------------|-------|-------|----------------|-------|-------|----------------|
| | | E | EE ⁴ (BSPP) | F | FB | G | J | K | R | RT | TF | UF | Y | LG | P | ZB max |
| 254.0 (10") | 1 | 320.7 | G2 | 42.9 | 46.0 | 93.7 | 93.7 | 39 | 244.3 | 25.4 28.6 | 403.2 | 482.6 | 120.7 127.0 | 308.0 | 215.9 | 422.3 428.6 |
| 304.8 (12") | 2 | 377.8 | G2½ | 49.2 | 52.4 | 112.7 | 112.7 | See note 2 | 290.8 | 33.3 28.6 | 469.9 | 558.8 | 136.5 142.9 | 368.3 | 257.2 | 449.3 455.6 |

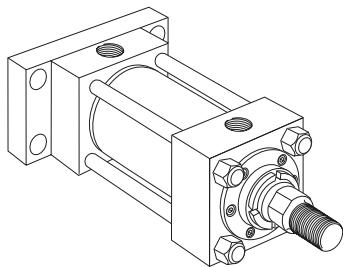
Notes

- 1 The dimensional drawings above show 254mm (10") bore models fitted with four tie rods, but can also be used to determine dimensions for 304.8mm (12") bore models fitted with 16 tie rods

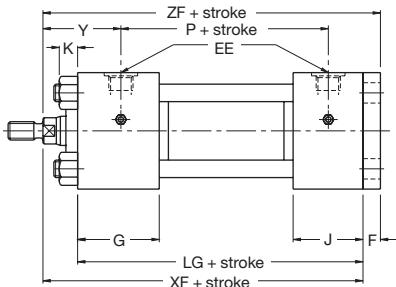
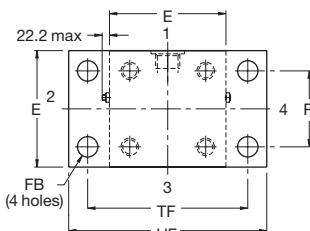


- 2 Tie rod nuts are flush with cap on 304.8mm (12") cylinders
- 3 For maximum pressure ratings, see page 32
- 4 Flange ports to ISO 6162 are also available – see page 35

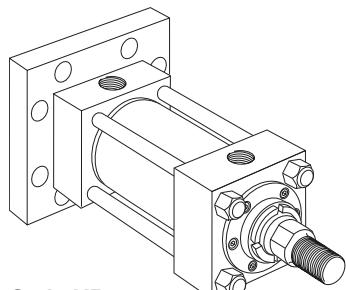
All dimensions are in millimetres unless otherwise stated.



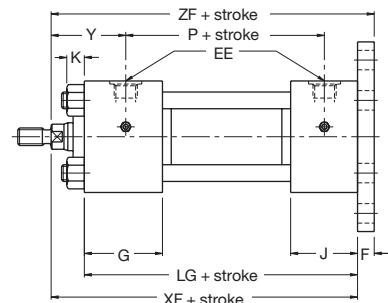
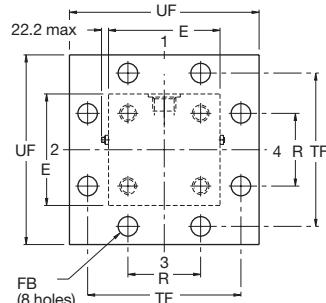
Style H
Cap Rectangular Flange
(NFPA Style MF2)



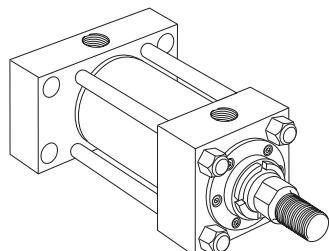
See Notes 1, 2, 3, 4



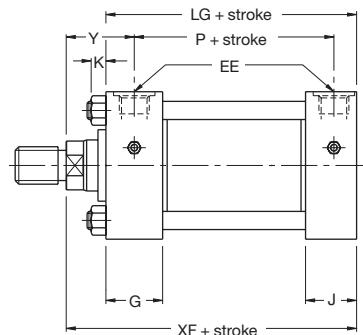
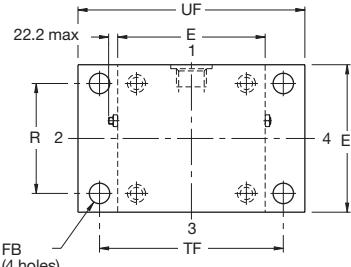
Style HB
Cap Square Flange
(NFPA Style MF6)



See Notes 1, 2, 4



Style HH
Rectangular Cap
(NFPA Style ME6)



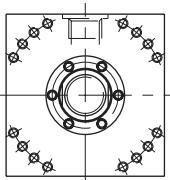
See Notes 1, 2, 4

Dimensions H, HB & HH See also rod end dimensions, page 40 & mounting information, page 30

| Bore Ø | Rod No. | E | EE ⁴ (BSPP) | F | FB | G | J | K | R | TF | UF | Y | + Stroke | | | |
|-------------|---------|-------|------------------------|------|------|-------|-------|------------|-------|-------|-------|----------------|----------|-------|----------------|----------------|
| | | | | | | | | | | | | | LG | P | XF | ZF |
| 254.0 (10") | 1 2 | 320.7 | G2 | 42.9 | 46.0 | 93.7 | 93.7 | 39 | 244.3 | 403.2 | 482.6 | 120.7 127.0 | 308.0 | 215.9 | 382.6 388.9 | 425.5 431.8 |
| 304.8 (12") | 1 2 | 377.8 | G2½ | 49.2 | 52.4 | 112.7 | 112.7 | See note 2 | 290.8 | 469.9 | 558.8 | 136.5 142.9 | 368.3 | 257.2 | 449.3 455.6 | 498.5 504.8 |

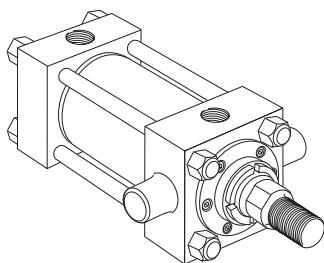
Notes

1 The dimensional drawings above show 254mm (10") bore models fitted with four tie rods, but can also be used to determine dimensions for 304.8mm (12") bore models fitted with 16 tie rods

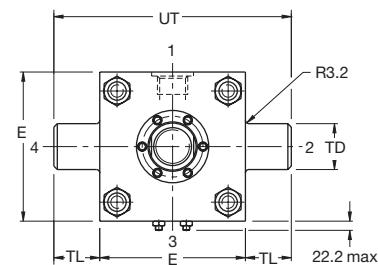
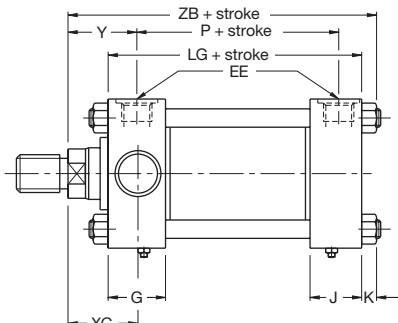


2 Tie rod nuts are flush with head on 304.8mm (12") cylinders
3 For maximum pressure ratings, see page 32
4 Flange ports to ISO 6162 are also available – see page 35

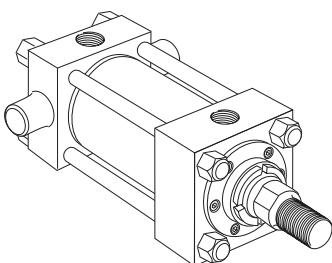
All dimensions are in millimetres unless otherwise stated.



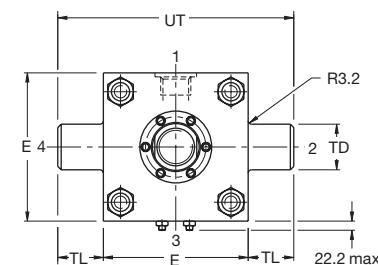
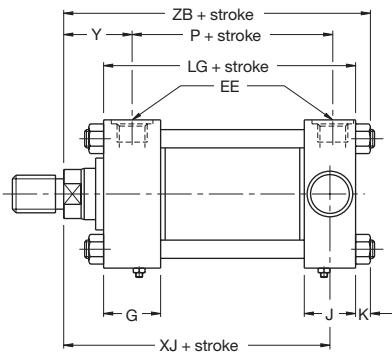
Style D
Head Trunnion
(NFPA Style MT1)



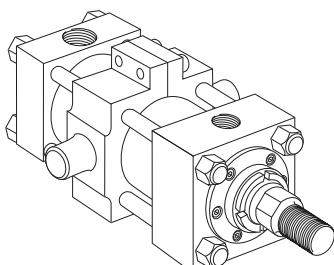
See Notes 1, 2, 4



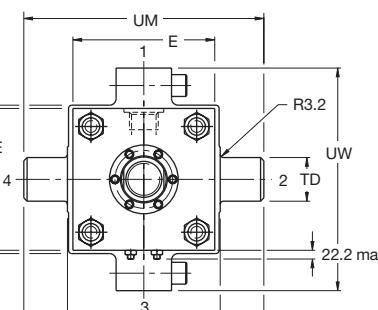
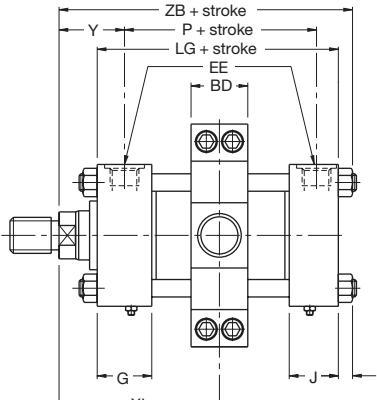
Style DB
Cap Trunnion
(NFPA Style MT2)



See Notes 1, 2, 4



Style DD
Intermediate Fixed Trunnion
(NFPA Style MT4)



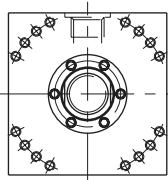
See Notes 1, 2, 3, 4

Dimensions D, DB, & DD See also rod end dimensions, page 40 & mounting information, page 30

| Bore Ø | Rod No. | + Stroke | | | | | | | | | | | | | | | | | |
|----------------|---------|----------|-------|------------------------|-------|------------|---|-------|-------|-------|-------|-------|-------|----------------------|----------------|-------|-------|----------------|----------------|
| | | BD | E | EE ⁴ (BSPP) | G & J | K | TD ^{+0.000} ^{-0.025} | TL | TM | TY | UM | UT | UW | Min. ³ XI | XG & Y | LG | P | XJ | ZB max |
| 254.0 (10") | 1 | 114.3 | 320.7 | G2 | 93.7 | 39 | 88.9 | 88.9 | 355.6 | 330.2 | 533.4 | 498.5 | 444.5 | 225.4 231.8 | 120.7 127.0 | 308.0 | 215.9 | 336.6 342.9 | 421.6 427.9 |
| 304.8 (12") | 1 | 139.7 | 377.8 | G2 ^{1/2} | 112.7 | See note 2 | 101.6 | 101.6 | 419.1 | 393.7 | 622.3 | 581.0 | 527.1 | 263.5 269.9 | 136.5 142.9 | 368.3 | 257.2 | 393.7 400.0 | 449.3 455.6 |

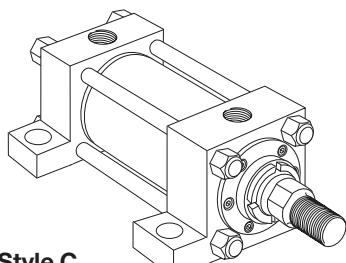
Notes

1 The dimensional drawings above show 254mm (10") bore models fitted with four tie rods, but can also be used to determine dimensions for 304.8mm (12") bore models fitted with 16 tie rods

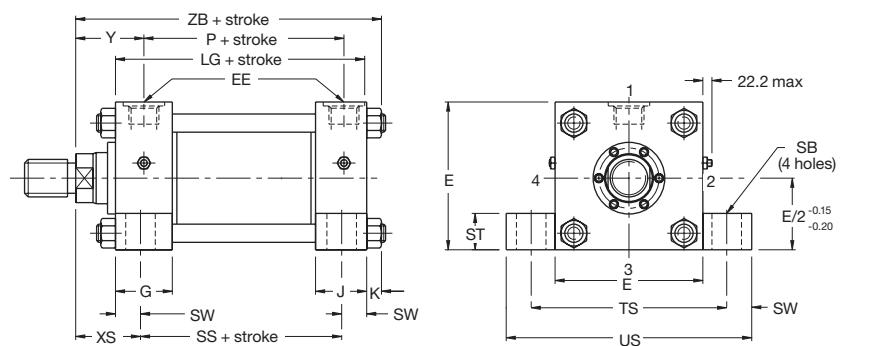


2 Tie rod nuts are flush with head and cap on 304.8mm (12") cylinders
3 Dimension XI to be specified by customer
4 Flange ports to ISO 6162 are also available – see page 35

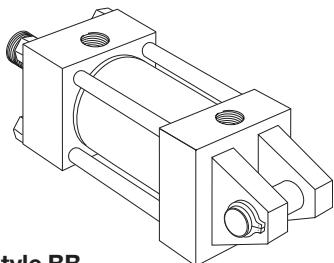
All dimensions are in millimetres unless otherwise stated.



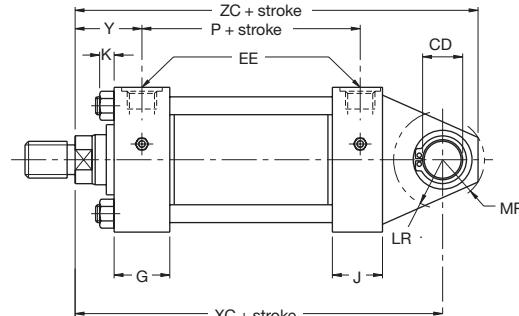
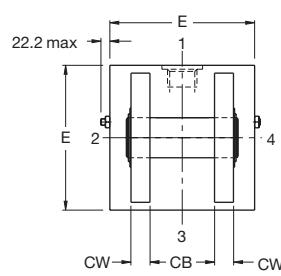
Style C
Side Lug
(NFPA Style MS2)



See Notes 1, 2, 3, 4



Style BB
Cap Fixed Clevis
(NFPA Style MP1)



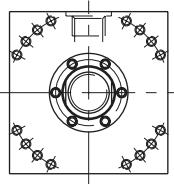
See Notes 1, 2, 4, 5

Dimensions C & BB See also rod end dimensions, page 40 & mounting information, page 30

| Bore Ø | Rod No. | + Stroke | | | | | | | | | | | | | | | | LG | P | SS | XC | ZB max | ZC | |
|----------------|------------|----------|-------------------------------|------|-------|---------------------------|-------|---------------|-------|-------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-------|-------|
| | | CB | CD ^{+0.00 -0.08} | CW | E | EE ⁴ (BSPP) | G | J | K | LR | MR | SB | ST | SW | TS | US | XS | Y | | | | | | |
| 254.0 (10") | 1 | 101.6 | 88.93 | 50.8 | 320.7 | G2 | 93.7 | | 39 | 98.4 | 90.0 | 39 | 57.2 | 41.3 | 403.2 | 485.8 | 115.9 | 120.7 | 308.0 | 215.9 | 225.4 | 483.4 | 421.6 | 573.1 |
| | 2 | | | | | | | | | | | | | | | 122.2 | 127.0 | | 490.5 | 427.9 | 579.4 | | | |
| 304.8 (12") | 1 | 114.3 | 101.63 | 57.2 | 377.8 | G2 ^{1/2} | 112.7 | See note 2 | 111.1 | 111.1 | 39 | 76.2 | 50.8 | 479.4 | 581.0 | 131.8 | 136.5 | 368.3 | 257.2 | 266.7 | 563.6 | 449.3 | 665.2 | |
| | 2 | | | | | | | | | | | | | | | 138.1 | 142.9 | | 569.9 | 455.6 | 671.5 | | | |

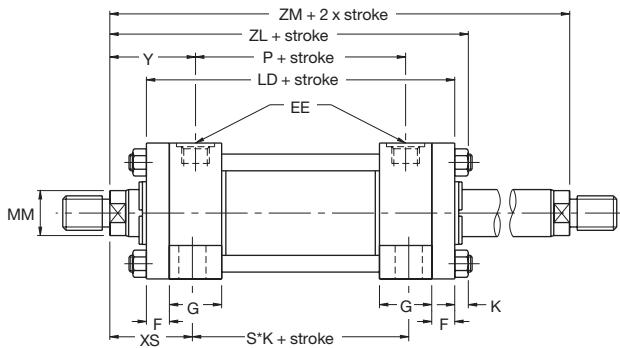
Notes

1 The dimensional drawings above show 254mm (10") bore models fitted with four tie rods, but can also be used to determine dimensions for 304.8mm (12") bore models fitted with 16 tie rods



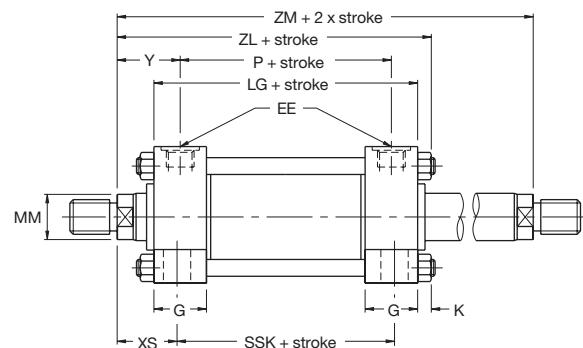
2 Tie rod nuts are flush with head and cap on 304.8mm (12") cylinders
3 Style C cylinders can be supplied with the cylinder ports arranged for mounting and sealing to a manifold surface – see page 31
4 Flange ports to ISO 6162 are also available – see page 35
5 Supplied complete with pivot pin

All dimensions are in millimetres unless otherwise stated.



Double Rod Cylinders
38.1 to 203.2mm Bores

Available with Styles TB, TD, J, JB, JJ, C, F, D, DD, and G



Double Rod Cylinders
254 and 304.8mm Bores

Available with Styles J, JB, JJ, C, D, and DD

Mounting Styles and Codes

Double rod cylinders are denoted by a 'K' in the model code, shown on page 41.

Dimensions

To obtain dimensional information for double rod cylinders, first select the desired mounting style by referring to the corresponding single rod models shown on the preceding pages. Dimensions for the appropriate single rod model should be supplemented by those from the table opposite to provide a full set of dimensions.

Rod Strength

Double rod cylinders employ two separate piston rods, with one screwed into the end of the other within the piston rod assembly. As a result, one piston rod is stronger than the other. The stronger rod is identified by the letter 'K' stamped on its end, and its pressure limitations with a 4:1 design factor are identical to those shown in the table on page 32 for the equivalent single rod assembly. The weaker rod should always be used for the lighter duty. Pressure limitations for the weaker rod in pull applications at a 4:1 design factor are also identical to those on page 32, except for the bore sizes shown in the table below.

| Bore Ø | Rod Diameter | 4 : 1 Design Factor (bar) |
|---------------|---------------|---------------------------|
| 63.5 (2 1/2") | 25.4 (1") | 95 |
| 82.6 (3 1/4") | 34.9 (1 5/8") | 115 |

Combination Rods

Double rod cylinders with rods of differing rod diameters are also available. Please contact the factory for details.

Cushioning

Double rod cylinders can be supplied with cushions at either or both ends. Cushioning requirements should be specified by inserting a 'C' in the ordering code – see page 41. Double rod cylinders with cushioning are supplied with floating cushion sleeves as standard.

| Bore Ø | Rod No. | MM Rod Diameter | + Stroke | | | | | + 2x Stroke |
|---------------|---------|----------------------------|------------------------------------|----------------------------------|------------------|------------------|------------------|----------------------------------|
| | | | LD ¹ LG ² | ZL | SEK ³ | SNK ⁴ | SSK ⁵ | |
| 38.1 (1 1/2") | 1 | 15.9 (5/8") | 142.9 | 168.3 177.8 | 187.3 | 73.0 | 104.8 | 174.6 193.7 |
| | 2 | 25.4 (1") 34.9 (1 5/8") | 155.6 | 185.7 192.1 | 203.3 | 73.0 | 98.4 | 193.7 206.4 |
| 50.8 (2") | 1 | 25.4 (1") | 158.8 | 188.9 201.6 195.2 | 206.4 | 76.2 | 92.1 | 196.9 222.3 209.6 |
| | 2 | 44.5 (1 3/4") | 184.2 | 220.7 230.2 227.0 | 241.4 | 88.9 | 111.1 | 228.6 247.7 241.3 |
| | 3 | 34.9 (1 5/8") | 196.9 | 236.5 246.1 239.7 | 254.0 | 95.3 | 108.0 | 247.7 266.7 254.0 |
| 63.5 (2 1/2") | 1 | 25.4 (1") | 209.6 | 258.8 265.1 265.1 265.1 | 285.7 | 108.0 | 120.7 | 266.7 279.4 279.4 279.4 |
| | 2 | 44.5 (1 3/4") | 238.1 | 292.1 | 323.9 | 123.8 | 130.2 | 301.6 |
| | 3 | 63.5 (2 1/2") | 266.7 | 323.9 | 358.7 | 136.5 | 146.1 | 330.2 |
| | 4 | 50.8 (2") | 292.1 | 350.8 | 393.7 | 156.6 | 171.5 | 355.6 |
| 82.6 (3 1/4") | 1 | 34.9 (1 5/8") | 308.0 | 422.3 | — | — | 225.4 | 457.2 |
| | 2 | 50.8 (2") | 368.3 | 449.3 | — | — | 266.7 | 532.3 |
| | 3 | 44.5 (1 3/4") | | | | | | |

¹ Use LD dimensions for 38.1mm to 203.2mm (1 1/2" to 8") bore sizes

² Use LG dimensions for 254.0mm & 304.8mm (10" & 12") bore sizes

³ SEK dimensions apply to mounting style KG only

⁴ SNK dimensions apply to mounting style KF only

⁵ SSK dimensions apply to mounting style KC only

Style 9 Rod Ends

If a stroke of less than 25mm on bore sizes up to 82.6mm (3 1/4"), or a stroke of less than 100mm on bore sizes of 101.6mm (4") and over, is required, where Style 9 rod ends are required at both ends, please consult the factory.

All dimensions are in millimetres unless otherwise stated.

Accessory Selection

Accessories for the rod end of a cylinder are selected by reference to the rod end thread, shown on pages 3 and 40, while accessories for use at the cap end are selected by cylinder bore size.

Rod and Cap End Accessories

Rod End – rod clevis, eye bracket and pivot pin
 – plain rod eye, clevis bracket and pivot pin
 – rod eye with spherical bearing

Cap End – eye bracket for style BB mounting
 (Note: pivot pin is supplied with cylinder)

Rod End Fatigue

Fatigue failure of the rod end is minimised by using a shouldered rod end, ie: Style 4, and tightening accessories securely against the rod shoulder. Where this is not the case, derating of the maximum working pressure may be required – please consult the factory.

Rod Clevis, Eye Bracket and Pivot Pin

| Thread KK | Rod Clevis | Eye Bracket | Pivot Pin | Nominal Force kN | Mass kg |
|-----------|------------|--------------------|-----------|------------------|---------|
| M10x1.5 | 50940G | 69195 | 68368 | 18.3 | 0.7 |
| M12x1.5 | 50941G | 69195 | 68368 | 18.3 | 0.7 |
| M20x1.5 | 50942G | 96196 | 68369 | 46.8 | 2.3 |
| M22x1.5 | 50943G | 85361 ¹ | 68370 | 83.8 | 5.2 |
| M26x1.5 | 50944G | 85361 ¹ | 68370 | 91.0 | 5.1 |
| M33x2 | 50945G | 69198 | 68371 | 94.5 | 9.9 |
| M39x2 | 50946G | 85362 ¹ | 68372 | 203.3 | 19.5 |
| M45x2 | 50947G | 85363 ¹ | 68373 | 312.1 | 28.6 |
| M48x2 | 50948G | 85363 ¹ | 68373 | 312.1 | 28.5 |
| M58x3 | 50949G | 85364 ¹ | 68374 | 420.0 | 48.4 |
| M64x2 | 50950G | 85365 ¹ | 68375 | 420.0 | 54.9 |
| M68x2 | 50951G | 85365 ¹ | 68375 | 543.6 | 63.1 |
| M76x2 | 50952G | 73538 | 73545 | 256.0 | 104.8 |
| M90x2 | 50953G | 73539 | 73547 | 334.4 | 157.8 |
| M100x2 | 50954G | 73539 | 73547 | 334.4 | 156.6 |
| M110x2 | – | – | – | – | – |

¹ Cylinder accessory dimensions conform to NFPA recommended standard, NFPA/T3.6.8.R1 - 1984

Rod Eye with Spherical Bearing

| Thread KK | Part No. | Torque Load Nm | Mass kg |
|-----------|----------|----------------|---------|
| M16x1.5 | 145239 | 13 | 0.4 |
| M20x1.5 | 145240 | 13 | 0.7 |
| M27x2 | 145241 | 32 | 1.2 |
| M33x2 | 145242 | 32 | 2.1 |
| M42x2 | 145243 | 64 | 4.4 |
| M48x2 | 145244 | 80 | 7.6 |
| M64x3 | 145245 | 195 | 14.5 |

Tie Rod Cylinders**2H Series****Load Capacity**

The load capacities of the accessories shown on these pages is the recommended maximum load based on a 4:1 factor of safety in tension. (Pivot pin is rated in shear). Before specifying, compare the actual load or the pull force at maximum operating pressure of the cylinder with the load capacity of the accessory you plan to use. If the load or pull force of the cylinder exceeds the load capacity of the accessory, please consult the factory.

Pivot Pin Diameters

To obtain the same diameter of pivot pin at the rod end and cap end of a style BB clevis-mounted cylinder fitted with a rod clevis or plain rod eye, a no. 1 rod should be specified.

Pivot pins of the same diameter can be obtained at each end of a style SBa cylinder fitted with a rod end spherical bearing by specifying a style 7 rod end and nos. 2, 3 or 4 rods, as indicated in the table on page 3.

Plain Rod Eye, Clevis Bracket and Pivot Pin

| Thread KK | Plain Rod Eye | Clevis Bracket | Pivot Pin | Nominal Force kN | Mass kg |
|-----------|---------------|----------------|-----------|------------------|---------|
| M10x1.5 | 69089G | 69205 | 68368 | 22.3 | 1.3 |
| M12x1.5 | 69090G | 69205 | 68368 | 25.4 | 1.3 |
| M20x1.5 | 69091G | 69206 | 68369 | 54.0 | 3.2 |
| M22x1.5 | 69092G | 69207 | 68370 | 58.0 | 6.6 |
| M26x1.5 | 69093G | 69207 | 68370 | 85.6 | 6.6 |
| M33x2 | 69094G | 69208 | 68371 | 149.4 | 12.7 |
| M39x2 | 69095G | 69209 | 68372 | 151.6 | 23.4 |
| M45x2 | 69096G | 69210 | 69215 | 147.2 | 41.1 |
| M48x2 | 69097G | 69210 | 69215 | 147.2 | 41.5 |
| M58x2 | 69098G | 69211 | 68374 | 155.6 | 51.2 |
| M64x2 | 69099G | 69212 | 68375 | 150.7 | 65.2 |
| M68x2 | 69100G | 69213 | 69216 | 164.6 | 69.5 |
| M76x2 | 73536G | 73542 | 73545 | 372.3 | 126.7 |
| M90x2 | 73437G | 73542 | 73545 | 372.3 | 124.0 |
| M100x2 | 73438G | 73543 | 82181 | 457.5 | 180.7 |
| M110x2 | 73439G | 73544 | 73547 | 483.4 | 173.5 |

Cap End Eye Bracket for Style BB Cylinders

| Bore Ø | Eye Bracket Part No. | Nominal Force kN | Mass kg |
|--------------------------|----------------------|------------------|---------|
| 38.1 (1 $\frac{1}{2}$ ') | 69195 | 18.3 | 0.4 |
| 50.8 (2") | 69196 | 46.8 | 1.5 |
| 63.5 (2 $\frac{1}{2}$ ') | 69196 | 46.8 | 1.5 |
| 82.6 (3 $\frac{1}{4}$ ') | 85361 ¹ | 91.0 | 3.4 |
| 101.6 (4") | 69198 | 94.5 | 5.6 |
| 127.0 (5") | 85362 ¹ | 220.6 | 11.1 |
| 152.4 (6") | 85363 ¹ | 312.1 | 17.0 |
| 177.8 (7") | 85364 ¹ | 420.0 | 27.4 |
| 203.2 (8") | 85365 ¹ | 543.6 | 35.8 |
| 254.0 (10") | 73538 | 256.0 | 55.6 |
| 304.8 (12") | 73539 | 334.4 | 84.3 |

All dimensions are in millimetres unless otherwise stated.

Rod Clevis, Eye Bracket and Pivot Pin

Rod Clevis Dimensions

| Part No. | A | CB | CD ^{+0.10} _{+0.05} | CE | CW | ER | KK | Nominal Force kN | Mass kg |
|----------|-------|-------|---|-------|------|-------|---------|------------------|---------|
| 50940G | 19.1 | 19.8 | 12.70 | 38.1 | 12.7 | 12.7 | M10x1.5 | 18.9 | 0.2 |
| 50941G | 19.1 | 19.8 | 12.70 | 38.1 | 12.7 | 12.7 | M12x1.5 | 21.9 | 0.2 |
| 50942G | 28.6 | 32.6 | 19.05 | 54.0 | 15.9 | 19.1 | M20x1.5 | 49.9 | 0.6 |
| 50943G | 41.3 | 38.9 | 25.40 | 74.6 | 19.1 | 25.4 | M22x1.5 | 83.8 | 1.3 |
| 50944G | 41.3 | 38.9 | 25.40 | 74.6 | 19.1 | 25.4 | M26x1.5 | 96.7 | 1.3 |
| 50945G | 50.8 | 51.6 | 34.93 | 95.3 | 25.4 | 34.9 | M33x2 | 149.4 | 3.1 |
| 50946G | 57.2 | 64.7 | 44.45 | 114.3 | 31.8 | 44.5 | M39x2 | 203.3 | 6.0 |
| 50947G | 76.2 | 64.7 | 50.80 | 139.7 | 31.8 | 50.8 | M45x2 | 317.9 | 8.4 |
| 50948G | 76.2 | 64.7 | 50.80 | 139.7 | 31.8 | 50.8 | M48x2 | 341.6 | 8.3 |
| 50949G | 88.9 | 77.4 | 63.50 | 165.1 | 38.1 | 63.5 | M58x2 | 480.2 | 15.1 |
| 50950G | 88.9 | 77.4 | 76.20 | 171.5 | 38.1 | 69.9 | M64x2 | 535.1 | 19.0 |
| 50951G | 88.9 | 77.4 | 76.20 | 171.5 | 38.1 | 69.9 | M68x2 | 589.9 | 18.7 |
| 50952G | 88.9 | 102.8 | 88.90 | 196.9 | 50.8 | 88.9 | M76x2 | 1048.8 | 34.1 |
| 50953G | 101.6 | 116.0 | 101.60 | 223.8 | 57.2 | 101.6 | M90x2 | 1292.2 | 49.8 |
| 50954G | 101.6 | 116.0 | 101.60 | 223.8 | 57.2 | 101.6 | M100x2 | 1480.0 | 48.6 |

Eye Bracket Dimensions

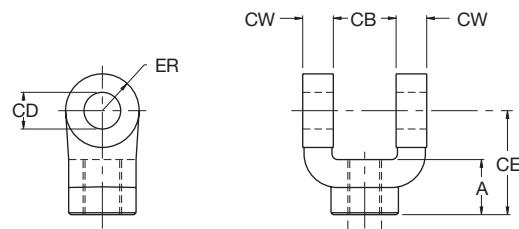
| Part No. | CB | CD ^{+0.10} _{+0.05} | DD | E | F | FL | LR | M | MR | R | Nominal Force kN | Mass kg |
|--------------------|-------|---|------|-------|------|-------|-------|-------|-------|-------|------------------|---------|
| 69195 | 19.1 | 12.70 | 10.3 | 63.5 | 9.5 | 28.6 | 19.1 | 12.7 | 14.3 | 41.4 | 18.3 | 0.4 |
| 69196 | 31.8 | 19.05 | 13.5 | 88.9 | 15.9 | 47.6 | 31.8 | 19.1 | 22.2 | 64.8 | 46.8 | 1.5 |
| 85361 ¹ | 38.1 | 25.40 | 16.7 | 114.3 | 22.2 | 60.3 | 38.1 | 25.4 | 31.8 | 82.6 | 91.0 | 3.4 |
| 69198 | 50.8 | 34.93 | 16.7 | 127.0 | 22.2 | 76.2 | 54.0 | 34.9 | 41.3 | 97.0 | 94.5 | 5.6 |
| 85362 ¹ | 63.5 | 44.45 | 23.0 | 165.1 | 28.6 | 85.7 | 57.2 | 44.5 | 54.0 | 125.7 | 220.6 | 11.1 |
| 85363 ¹ | 63.5 | 50.80 | 27.0 | 190.5 | 38.1 | 101.6 | 63.5 | 50.8 | 61.9 | 145.5 | 312.1 | 17.0 |
| 85364 ¹ | 76.2 | 63.50 | 30.2 | 215.9 | 44.5 | 120.6 | 76.2 | 63.5 | 76.2 | 167.1 | 420.0 | 27.4 |
| 85365 ¹ | 76.2 | 76.20 | 33.3 | 241.3 | 50.8 | 133.3 | 82.6 | 69.9 | 82.6 | 190.5 | 543.6 | 35.8 |
| 73538 | 101.6 | 88.90 | 46.0 | 320.7 | 42.9 | 144.5 | 101.6 | 88.9 | 95.3 | 244.3 | 256.0 | 55.6 |
| 73539 | 114.3 | 101.60 | 52.4 | 377.8 | 49.2 | 163.5 | 114.3 | 101.6 | 108.0 | 290.8 | 334.4 | 84.3 |

¹ Cylinder accessory dimensions conform to NFPA recommended standard, NFPA/T3.6.8.R1 - 1984

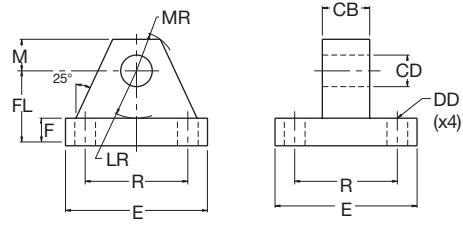
Pivot Pin for Clevis Bracket & Eye Bracket

| Part No. | CD ^{+0.00} _{-0.05} | CL | G | Nominal Force kN | Mass kg |
|----------|---|-------|-------|------------------|---------|
| 68368 | 12.73 | 45.8 | 56 | 38.4 | 0.1 |
| 68369 | 19.08 | 64.9 | 75 | 86.1 | 0.2 |
| 68370 | 25.43 | 77.4 | 88 | 152.9 | 0.5 |
| 68371 | 34.95 | 102.9 | 115 | 289.8 | 1.2 |
| 68372 | 44.48 | 128.3 | 143 | 469.1 | 2.4 |
| 68373 | 50.83 | 129.2 | 145 | 612.7 | 3.2 |
| 69215 | 50.83 | 140.9 | 158 | 612.7 | 3.5 |
| 68374 | 63.53 | 154.6 | 171 | 957.4 | 5.9 |
| 68375 | 76.23 | 154.2 | 173 | 1378.7 | 8.6 |
| 69216 | 76.23 | 167.2 | 185 | 1378.7 | 9.2 |
| 73545 | 88.93 | 205.2 | 225 | 1876.8 | 15.2 |
| 82181 | 101.63 | 219.8 | 254 | 2522.9 | 22.4 |
| 73547 | 101.63 | 231.2 | 266.7 | 2522.9 | 23.5 |

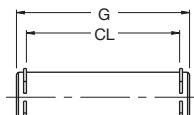
Rod Clevis (Female Clevis)



Eye Bracket



Pivot Pin for Clevis Bracket & Eye Bracket



All dimensions are in millimetres unless otherwise stated.

Plain Rod Eye, Clevis Bracket and Pivot Pin

Plain Rod Eye Dimensions

| Part No. | A min. | CA | CB | CD ^{+0.10 +0.05} | ER | KK | Nominal Force kN | Mass kg |
|----------|--------|-------|-------|-------------------------------|-------|---------|------------------|---------|
| 69089G | 19.1 | 38.1 | 19.1 | 12.70 | 18.3 | M10x1.5 | 22.3 | 0.2 |
| 69090G | 19.1 | 38.1 | 19.1 | 12.70 | 18.3 | M12x1.5 | 25.4 | 0.2 |
| 69091G | 28.6 | 52.4 | 31.8 | 19.05 | 27.0 | M20x1.5 | 54.0 | 0.5 |
| 69092G | 28.6 | 60.3 | 38.1 | 25.40 | 36.5 | M22x1.5 | 58.0 | 1.1 |
| 69093G | 41.3 | 71.4 | 38.1 | 25.40 | 36.5 | M26x1.5 | 96.8 | 1.1 |
| 69094G | 50.8 | 87.3 | 50.8 | 34.93 | 50.0 | M33x2 | 149.4 | 2.6 |
| 69095G | 57.2 | 101.6 | 63.5 | 44.45 | 63.5 | M39x2 | 200.6 | 5.1 |
| 69096G | 57.2 | 111.1 | 63.5 | 50.80 | 72.2 | M45x2 | 238.6 | 6.4 |
| 69097G | 76.2 | 127.0 | 63.5 | 50.80 | 72.2 | M48x2 | 334.4 | 6.8 |
| 69098G | 88.9 | 147.6 | 76.2 | 63.50 | 90.5 | M58x2 | 440.1 | 12.1 |
| 69099G | 88.9 | 155.6 | 76.2 | 76.20 | 108.0 | M64x2 | 490.5 | 16.0 |
| 69100G | 92.1 | 165.1 | 88.9 | 76.20 | 108.0 | M68x2 | 549.8 | 19.6 |
| 73536G | 101.6 | 193.7 | 101.6 | 88.90 | 126.2 | M76x2 | 719.3 | 31.1 |
| 73437G | 127.0 | 193.7 | 101.6 | 88.90 | 126.2 | M90x2 | 969.0 | 28.4 |
| 73438G | 139.7 | 231.8 | 114.3 | 101.60 | 144.5 | M100x2 | 1220.9 | 42.5 |
| 73439G | 139.7 | 231.8 | 127.0 | 101.60 | 144.5 | M110x2 | 1375.6 | 48.4 |

Clevis Bracket Dimensions

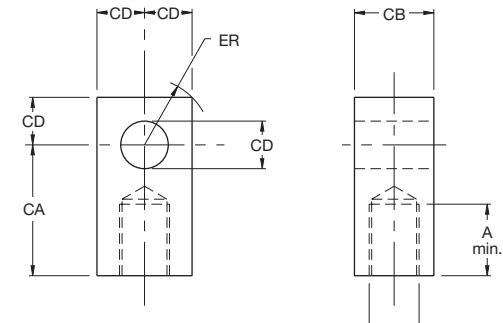
| Part No. | CB | CD ^{+0.10 +0.05} | CW | DD | E | F | FL | LR | M | MR | R | Nominal Force kN | Mass kg |
|----------|-------|-------------------------------|------|------|-------|------|-------|-------|-------|-------|-------|------------------|---------|
| 69205 | 19.8 | 12.70 | 12.7 | 10.3 | 88.9 | 12.7 | 38.1 | 19.1 | 12.7 | 15.9 | 64.8 | 32.6 | 1.0 |
| 69206 | 32.6 | 19.05 | 15.9 | 13.5 | 127.0 | 15.9 | 47.6 | 30.2 | 19.1 | 23.0 | 97.0 | 62.4 | 2.5 |
| 69207 | 38.9 | 25.40 | 19.1 | 16.7 | 165.1 | 19.1 | 57.2 | 38.1 | 25.4 | 31.8 | 125.7 | 85.6 | 5.0 |
| 69208 | 51.6 | 34.93 | 25.4 | 16.7 | 190.5 | 22.2 | 76.2 | 50.8 | 34.9 | 42.1 | 145.5 | 164.6 | 8.8 |
| 69209 | 64.7 | 44.45 | 31.8 | 23.0 | 241.3 | 22.2 | 92.1 | 69.9 | 44.5 | 56.4 | 190.5 | 151.6 | 15.9 |
| 69210 | 64.7 | 50.80 | 38.1 | 27.0 | 323.9 | 25.4 | 108.0 | 81.0 | 57.2 | 70.6 | 238.8 | 147.2 | 31.2 |
| 69211 | 77.4 | 63.50 | 38.1 | 30.2 | 323.9 | 25.4 | 114.3 | 88.9 | 63.5 | 79.4 | 238.8 | 155.6 | 33.2 |
| 69212 | 77.4 | 76.20 | 38.1 | 33.3 | 323.9 | 25.4 | 152.4 | 108.0 | 76.2 | 91.3 | 238.8 | 150.7 | 40.7 |
| 69213 | 90.1 | 76.20 | 38.1 | 33.3 | 323.9 | 25.4 | 152.4 | 108.0 | 76.2 | 91.3 | 238.8 | 164.6 | 40.7 |
| 73542 | 102.8 | 88.90 | 50.8 | 46.0 | 393.7 | 42.9 | 169.9 | 127.0 | 88.9 | 104.8 | 304.8 | 372.3 | 80.4 |
| 73543 | 116.0 | 101.60 | 50.8 | 52.4 | 444.5 | 49.2 | 195.3 | 146.1 | 101.6 | 123.8 | 349.3 | 457.5 | 115.8 |
| 73544 | 128.2 | 101.60 | 50.8 | 52.4 | 444.5 | 49.2 | 195.3 | 146.1 | 101.6 | 123.8 | 349.3 | 483.4 | 101.6 |

Rod Eye with Spherical Bearing Dimensions – ISO 6982

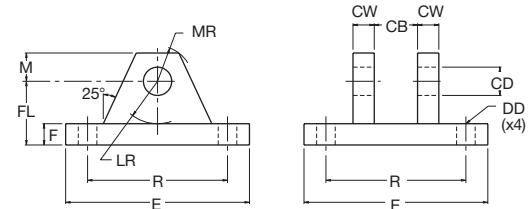
| Part No. | AX min. | b | C max. | CH | CN H7 | EF max. | EN h12 | KK (Style 7) | LF | Z | Clamp screw torque (Nm) | Mass kg |
|----------|---------|----|--------|-----|-------|---------|--------|--------------|----|----|-------------------------|---------|
| 145239 | 23 | 25 | 50 | 52 | 20 | 25 | 20 | M16x1.5 | 22 | 4° | 13 | 0.4 |
| 145240 | 29 | 30 | 62 | 65 | 25 | 32 | 25 | M20x1.5 | 27 | | 13 | 0.7 |
| 145241 | 37 | 38 | 76 | 80 | 32 | 40 | 32 | M27x2 | 32 | | 32 | 1.2 |
| 145242 | 46 | 47 | 97 | 97 | 40 | 50 | 40 | M33x2 | 41 | | 32 | 2.1 |
| 145243 | 57 | 58 | 118 | 120 | 50 | 63 | 50 | M42x2 | 50 | | 64 | 4.4 |
| 145244 | 64 | 70 | 142 | 140 | 63 | 71 | 63 | M48x2 | 62 | | 80 | 7.6 |
| 145245 | 86 | 90 | 180 | 180 | 80 | 90 | 80 | M64x3 | 78 | | 195 | 14.5 |

All dimensions are in millimetres unless otherwise stated.

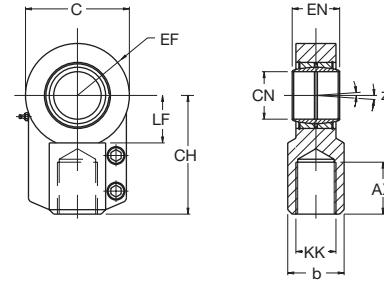
Plain Rod Eye



Clevis Bracket



Rod Eye with Spherical Bearing – ISO 6982



Mounting Styles

General guidance for the selection of mounting styles is given on page 9. The notes which follow provide information for use in specific applications.

Mounting Bolts

Parker recommends that mounting bolts with a minimum strength of ISO 898/1 grade 10.9 should be used for fixing cylinders to the machine or base. This recommendation is of particular importance where bolts are placed in tension or subjected to shear forces. Mounting bolts should be torque loaded to their manufacturer's recommended figures.

Tie Rod Nuts

Tie rod mounting nuts, with lubricated threads, should be to a minimum strength of ISO 898/2 grade 10, torque loaded to the figures shown.

| Tie Rod Nuts | |
|--------------|-------------------|
| Size A/F | Torque Nm min-max |
| 38.1 (1½") | 25-27 |
| 50.8 (2") | 60-65 |
| 63.5 (2½") | 60-65 |
| 82.6 (3¼") | 160-165 |
| 101.6 (4") | 175-180 |
| 127.0 (5") | 420-425 |
| 152.4 (6") | 715-735 |
| 177.8 (7") | 1080-1100 |
| 203.2 (8") | 1560-1580 |
| 254.0 (10") | 3390-3410 |
| 304.8 (12") | 715-735 |

Extended Tie Rods

The standard tie rod extension for cylinders with mounting styles TB, TC and TD is shown as BB in dimension tables. Longer or shorter extensions can be supplied. Cylinders are supplied with an additional set of mounting nuts – see table.

Cylinders may be ordered with extended tie rods in addition to another mounting style. The extended tie rods may then be used for mounting other systems or machine components.

Flange Mounted Cylinders

The diameter of the rod gland extension (B) at the head end can be used as a pilot to locate the cylinders in relation to the machine. After alignment has been obtained, the flanges may be drilled for pins or dowels to prevent movement.

Pivot Mountings

Pivot pins are supplied with style BB cap fixed clevis mounted cylinders. Pivot pins are not supplied with the spherical bearing mounting, style SBa, as the pin length will be determined by the customer's equipment.

Spherical Bearings

Where a spherical bearing mounting, style SBa, is specified for the cylinder, a rod eye with spherical bearing should be used at the rod end. The life of spherical bearings is influenced by factors such as specific load, direction of load, angle of oscillation, and type and frequency of lubrication. The maximum pressure rating for spherical bearing cylinders is 160 bar. If unusual operating conditions exist, please consult the factory.

Trunnion Mounted Cylinders

Trunnions require lubricated pillow blocks with minimum bearing clearances. Blocks should be aligned and mounted to eliminate bending moments on the trunnion pins. Self-aligning mounts must not be used to support the trunnions as bending forces can be set up.

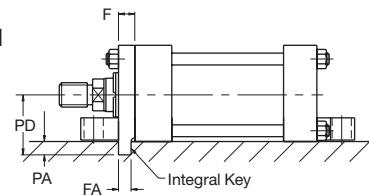
The position of an intermediate fixed trunnion is fixed during manufacture and its location must be specified at the time of order.

Foot Mountings and Thrust Keys

The turning moment which results from the application of force by a foot mounted cylinder must be resisted by secure mounting and effective guidance of the load. A thrust key modification is recommended to provide positive cylinder location.

Thrust key mountings eliminate the need for fitted bolts or external keys on Styles C, F and G side mounted cylinders.

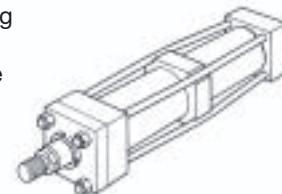
The gland retainer plate is extended below the nominal mounting surface to fit into a keyway milled into the mounting surface of the machine member. See 'Mounting Modifications' in the order code, page 41.



| Bore Ø | F Nom. | FA ^{+0.0} _{-0.075} | PA ^{+0.0} _{-0.2} | PD |
|------------|--------|--------------------------------------|------------------------------------|-------|
| 38.1 (1½") | 9.5 | 8 | 4.9 | 36.5 |
| 50.8 (2") | 15.9 | 14 | 8.0 | 46.0 |
| 63.5 (2½") | 15.9 | 14 | 8.1 | 52.4 |
| 82.6 (3¼") | 19.1 | 18 | 9.7 | 66.7 |
| 101.6 (4") | 22.2 | 22 | 11.2 | 74.6 |
| 127.0 (5") | 22.2 | 22 | 11.2 | 93.7 |
| 152.4 (6") | 25.4 | 25 | 12.7 | 108.0 |
| 177.8 (7") | 25.4 | 25 | 12.7 | 120.7 |
| 203.2 (8") | 25.4 | 25 | 12.7 | 133.4 |

Tie Rod Supports

To increase the resistance to buckling of long stroke cylinders, tie rod supports may be fitted. These move the tie rods radially outwards and allow longer than normal strokes to be used without the need for an additional mounting.



| Bore Ø | Stroke (metres) | | | | | | | | | | | | Number of supports req'd. |
|--------|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------------------------|
| | 0.9 | 1.2 | 1.5 | 1.8 | 2.1 | 2.4 | 2.7 | 3.0 | 3.3 | 3.6 | 3.9 | 4.2 | |
| 38.1 | – | – | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 4 | |
| 50.8 | – | – | – | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | |
| 63.5 | – | – | – | – | – | 1 | 1 | 1 | 1 | 1 | 2 | 2 | |
| 82.6 | – | – | – | – | – | – | – | 1 | 1 | 1 | 1 | 1 | |
| 101.6 | – | – | – | – | – | – | – | – | – | 1 | 1 | 1 | |

Bore sizes above 101.6mm (4") do not require tie rod supports.

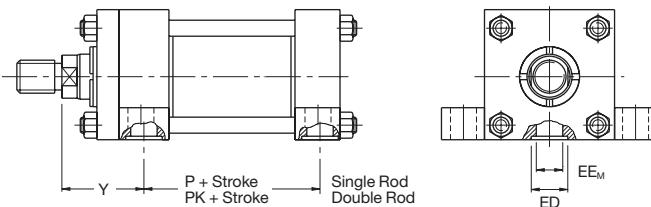
All dimensions are in millimetres unless otherwise stated.

Stroke Tolerances

Stroke length tolerances are required due to the build-up of tolerances of piston, head, cap and cylinder body. Standard production stroke tolerances are -0.4 to +0.8mm on all bore sizes and stroke lengths. For closer tolerances, please specify the required tolerance plus the operating temperature and pressure. Stroke tolerances of less than 0.4mm are generally impracticable due to the elasticity of cylinders and, in these cases, the use of a stroke limiter should be considered – see page 8.

Manifold Ports

Side mounted cylinders (Style C) can be supplied with the cylinder ports arranged for mounting and sealing to a manifold surface. The ports are drilled and counterbored for the O-ring seals provided. With these specifications, the mounting is designated Style CM. Please consult the factory.



| Bore Ø | Rod No. | Y ±0.8 | P ±0.8 | PK ±0.8 | EE _M | ED | Parker O-ring No. |
|---------------|---------|--------|--------|---------|-----------------|------|-------------------|
| 38.1 (1 1/2") | 1 | 50.8 | 73.0 | 73.0 | 19.1 | 28.6 | 2-212 |
| | 2 | 60.3 | | | | | |
| 50.8 (2") | 1 | 66.7 | 73.0 | 73.0 | 19.1 | 28.6 | 2-212 |
| | 2 | | | | | | |
| 63.5 (2 1/2") | 1 | 60.3 | 76.2 | 76.2 | 19.1 | 28.6 | 2-212 |
| | 2 | 73.0 | | | | | |
| | 3 | 66.7 | | | | | |
| 82.6 (3 1/4") | 1 | 69.9 | 88.9 | 88.9 | 25.4 | 34.9 | 2-216 |
| | 2 | 79.4 | | | | | |
| | 3 | 76.2 | | | | | |
| 101.6 (4") | 1 | 72.2 | 101.6 | 103.2 | 25.4 | 34.9 | 2-216 |
| | 2 | 81.8 | | | | | |
| | 3 | 75.4 | | | | | |
| 127.0 (5") | 1 | 79.4 | | | | | |
| | 2 | 85.7 | | | | | |
| | 3 | 85.7 | | | | | |
| | 4 | 85.7 | | | | | |
| 152.4 (6") | All | 88.9 | 130.2 | 123.8 | 31.8 | 41.3 | 2-220 |
| 177.8 (7") | All | 96.8 | 149.2 | 136.5 | 38.1 | 47.6 | 2-223 |
| 203.2 (8") | All | 100.0 | 168.3 | 155.6 | 38.1 | 47.6 | 2-223 |
| 254.0 (10") | 1 | 120.7 | 215.9 | 215.9 | 50.8 | 60.3 | 010404-0224 |
| | 2 | 127.0 | | | | | |
| 304.8 (12") | 1 | 136.5 | 257.2 | 257.2 | 63.5 | 73.0 | 010404-0256 |
| | 2 | 142.9 | | | | | |

All dimensions are in millimetres unless otherwise stated.

Calculation of Cylinder Diameter

Compression or 'Push' Applications

If the piston rod is in compression, use the 'Push Force' table:

1. Identify the operating pressure closest to that required.
2. In the same column, identify the force required to move the load (always rounding up).
3. In the same row, look along to the cylinder bore required.

If the cylinder envelope dimensions are too large, increase the operating pressure, if possible, and repeat the exercise.

Tension or 'Pull' Applications

If the rod is in tension, use the 'Deduction for Pull Force' table:

1. Follow the procedure for 'push' applications above.
2. Using the 'Deduction for Pull Force' table, identify the force indicated according to the rod and pressure selected.
3. Deduct this from the original 'push' force. The resultant is the net force available to move the load.

If this force is not large enough, repeat the process with a higher system operating pressure or larger cylinder diameter.

Push Force

| Bore Ø | Piston Area mm ² | Cylinder Push Force in kN | | | | | | Displacement per 10mm stroke Litres |
|---------------|-----------------------------|---------------------------|--------|--------|--------|---------|---------|-------------------------------------|
| | | 5 bar | 10 bar | 25 bar | 70 bar | 100 bar | 210 bar | |
| 38.1 (1 1/2") | 1140 | 0.6 | 1.1 | 2.9 | 8.0 | 11.4 | 24.0 | 0.0114 |
| 50.8 (2") | 2020 | 1.0 | 2.0 | 5.0 | 14.1 | 20.2 | 42.5 | 0.0202 |
| 63.5 (2 1/2") | 3170 | 1.6 | 3.2 | 7.9 | 22.2 | 31.7 | 66.6 | 0.0317 |
| 82.6 (3 1/4") | 5360 | 2.7 | 5.4 | 13.4 | 37.5 | 53.5 | 113 | 0.0535 |
| 101.6 (4") | 8110 | 4.0 | 8.1 | 20.3 | 56.8 | 81.1 | 170 | 0.0811 |
| 127.0 (5") | 12670 | 6.4 | 12.7 | 31.6 | 88.5 | 126 | 266 | 0.1267 |
| 152.4 (6") | 18240 | 9.1 | 18.3 | 45.5 | 127 | 182 | 383 | 0.1827 |
| 177.8 (7") | 24830 | 12.4 | 24.9 | 62.2 | 174 | 248 | 523 | 0.2486 |
| 203.2 (8") | 32430 | 16.2 | 32.5 | 81.1 | 227 | 324 | 682 | 0.3246 |
| 254.0 (10") | 50670 | 25.4 | 50.6 | 127 | 354 | 506 | 1065 | 0.5073 |
| 304.8 (12") | 72970 | 36.5 | 73.0 | 182 | 510 | 730 | 1532 | 0.7294 |

Deduction for Pull Force

| Piston Rod Ø | Piston Rod Area mm ² | Piston Rod Force in kN | | | | | | Displacement per 10mm stroke Litres |
|----------------|---------------------------------|------------------------|--------|--------|--------|---------|---------|-------------------------------------|
| | | 5 bar | 10 bar | 25 bar | 70 bar | 100 bar | 210 bar | |
| 15.9 (5/8") | 200 | 0.1 | 0.2 | 0.5 | 1.4 | 2.0 | 4.2 | 0.0020 |
| 25.4 (1") | 500 | 0.3 | 0.5 | 1.3 | 3.5 | 5.0 | 10.5 | 0.0050 |
| 34.9 (1 1/8") | 960 | 0.5 | 1.0 | 2.4 | 6.8 | 9.6 | 20.2 | 0.0097 |
| 44.5 (1 3/4") | 1560 | 0.8 | 1.6 | 3.9 | 10.9 | 15.6 | 32.8 | 0.0156 |
| 50.8 (2") | 2020 | 1.0 | 2.0 | 5.0 | 14.1 | 20.2 | 42.5 | 0.0202 |
| 63.5 (2 1/2") | 3170 | 1.6 | 3.2 | 7.9 | 22.2 | 31.7 | 66.6 | 0.0317 |
| 76.2 (3") | 4560 | 2.3 | 4.6 | 11.4 | 32.0 | 45.6 | 95.8 | 0.0456 |
| 88.9 (3 1/2") | 6210 | 3.1 | 6.2 | 15.5 | 43.4 | 62.0 | 130 | 0.0621 |
| 101.6 (4") | 8110 | 4.0 | 8.1 | 20.3 | 56.8 | 81.1 | 171 | 0.0811 |
| 127.0 (5") | 12670 | 6.4 | 12.7 | 31.6 | 88.7 | 127 | 266 | 0.1267 |
| 139.7 (5 1/2") | 15330 | 7.7 | 15.3 | 38.4 | 107 | 153 | 322 | 0.1523 |
| 177.8 (7") | 24830 | 12.4 | 24.9 | 62.2 | 174 | 249 | 523 | 0.2486 |
| 215.8 (8 1/2") | 36610 | 18.3 | 36.6 | 91.5 | 257 | 366 | 769 | 0.3663 |

Low Pressure Operation

At low operating pressures, a wide range of application factors such as seal friction and mounting alignment begin to affect cylinder performance. Low friction seals are available to special order, to optimise performance at low pressures. For information, please consult the factory.

Maximum Pressure

The majority of Series 2H cylinders are suitable for pressures up to 210 bar for heavy-duty service with hydraulic oil. The 4:1 design factor rating shown is conservative for continuous severe applications. Safety factors at other pressures can be calculated from this rating. Mounting styles, stroke, etc., should be considered because of the limiting effect they may have on these ratings.

Three main areas of cylinder design may be affected by fatigue stress at lower pressures: the cylinder body (pressure envelope), the cylinder mountings, and the piston rod. The maximum pressures indicated in the tables are based on pure tensile and compressive loadings, without the presence of any bending stresses. Where it is impractical to avoid side loadings, eg: by the use of pivot mountings, please consult the factory.

Cylinder Body (Pressure Envelope)

In many applications, the pressure developed within a cylinder may be greater than the working pressure, due to pressure intensification across the piston and cushioning, eg: in meter-out circuits. In most cases, this intensification does not affect the cylinder mountings or piston rod threads in the form of increased loading. This induced pressure should not exceed 320 bar. If in doubt, please consult the factory.

For pressure limitations of specific cylinders, please refer to the European cylinder InPhorm selection program HY07-1260/Eur.

Maximum Pressure Ratings

| Bore Ø (with rod no. 1) | 4 : 1 Design Factor (yield) | | Heavy-duty Service | |
|----------------------------|-----------------------------|-------|--------------------|-------|
| | (bar) | (psi) | (bar) | (psi) |
| 38.1 (1½") | 145 | 2040 | 210 | 3000 |
| 50.8 (2") | 165 | 2340 | 210 | 3000 |
| 63.5 (2½") | 135 | 1920 | 210 | 3000 |
| 82.6 (3¼") | 150 | 2100 | 210 | 3000 |
| 101.6 (4") | 145 | 1970 | 210 | 3000 |
| 127.0 (5") | 135 | 1900 | 210 | 3000 |
| 152.4 (6") | 150 | 2100 | 210 | 3000 |
| 177.8 (7") | 130 | 1840 | 210 | 3000 |
| 203.2 (8") | 145 | 1980 | 210 | 3000 |
| 254.0 (10") | 155 | 2200 | 210 | 3000 |
| 304.8 (12") | 170 | 2380 | 210 | 3000 |

Maximum Pressure for H and J Mountings

| Bore Ø | Style H Mounting ¹ Pull applications (bar) | | | | | Style J Mounting ² Push applications (bar) | | | | |
|-------------|--|-----|-----|-----|-----|--|-----|-----|----|----|
| | Rod Numbers | | | | | Rod Numbers | | | | |
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 38.1 (1½") | 210 | 210 | — | — | — | 180 | 110 | — | — | — |
| 50.8 (2") | 210 | 210 | — | — | — | 180 | 110 | — | — | — |
| 63.5 (2½") | 210 | 210 | 210 | — | — | 180 | 110 | 130 | — | — |
| 82.6 (3¼") | 210 | 210 | 210 | — | — | 180 | 110 | 145 | — | — |
| 101.6 (4") | 210 | 210 | 210 | — | — | 180 | 110 | 125 | — | — |
| 127.0 (5") | 210 | 210 | 180 | 195 | — | 160 | 60 | 115 | 85 | — |
| 152.4 (6") | 210 | 210 | 180 | 195 | — | 130 | 60 | 100 | 75 | — |
| 177.8 (7") | 150 | 150 | 120 | 125 | — | 110 | 40 | 90 | 70 | — |
| 203.2 (8") | 150 | 150 | 120 | — | 130 | 70 | 40 | 55 | — | 45 |
| 254.0 (10") | 210 | — | — | — | — | 72 | 46 | — | — | — |
| 304.8 (12") | 210 | — | — | — | — | Not recommended | | | | |

¹ For pressures exceeding those shown use mounting HB or HH

² For pressures exceeding those shown use mounting JB or JJ

All dimensions are in millimetres unless otherwise stated.

Piston Rod Size Selection

For cylinders in compression (push) applications, the piston rod has to be of sufficient diameter to provide the necessary column strength. This is of particular importance in long stroke applications – see ‘Long Strokes and Stop Tubes’, page 34.

1. Determine the type of cylinder mounting style and rod end connection to be used. From the Stroke Factor table below, identify which factor corresponds to the application.
2. Using this stroke factor, determine the ‘basic length’ from the equation:

$$\text{Basic Length} = \text{Net Stroke} \times \text{Stroke Factor}$$

(The Piston Rod Selection Chart on page 34 is prepared for standard rod extensions beyond the face of the gland retainers. For rod extensions greater than standard, add the increases to the net stroke to obtain the ‘basic length’.)

3. Calculate the load imposed for the compression application

by multiplying the full bore area of the cylinder by the system pressure, or by referring to the Push and Pull Force charts on page 31.

4. Using the Piston Rod Selection Chart on page 34, look along the values of ‘basic length’ and force as found in 2 and 3 above, and note the point of intersection.

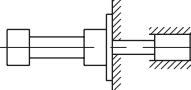
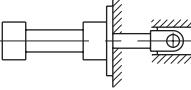
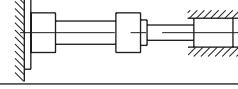
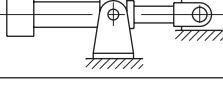
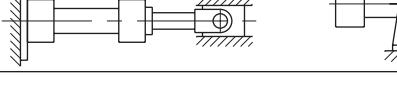
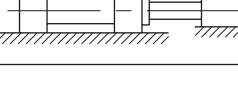
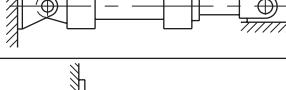
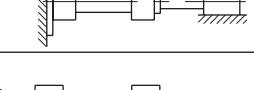
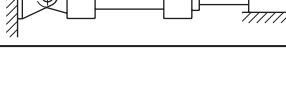
The correct piston rod diameter is read from the diagonally curved line **above** the point of intersection.

For cylinders in tensile (pull) applications, the rod size is selected by specifying standard cylinders with standard rod diameters and using them at or below the rated pressure.

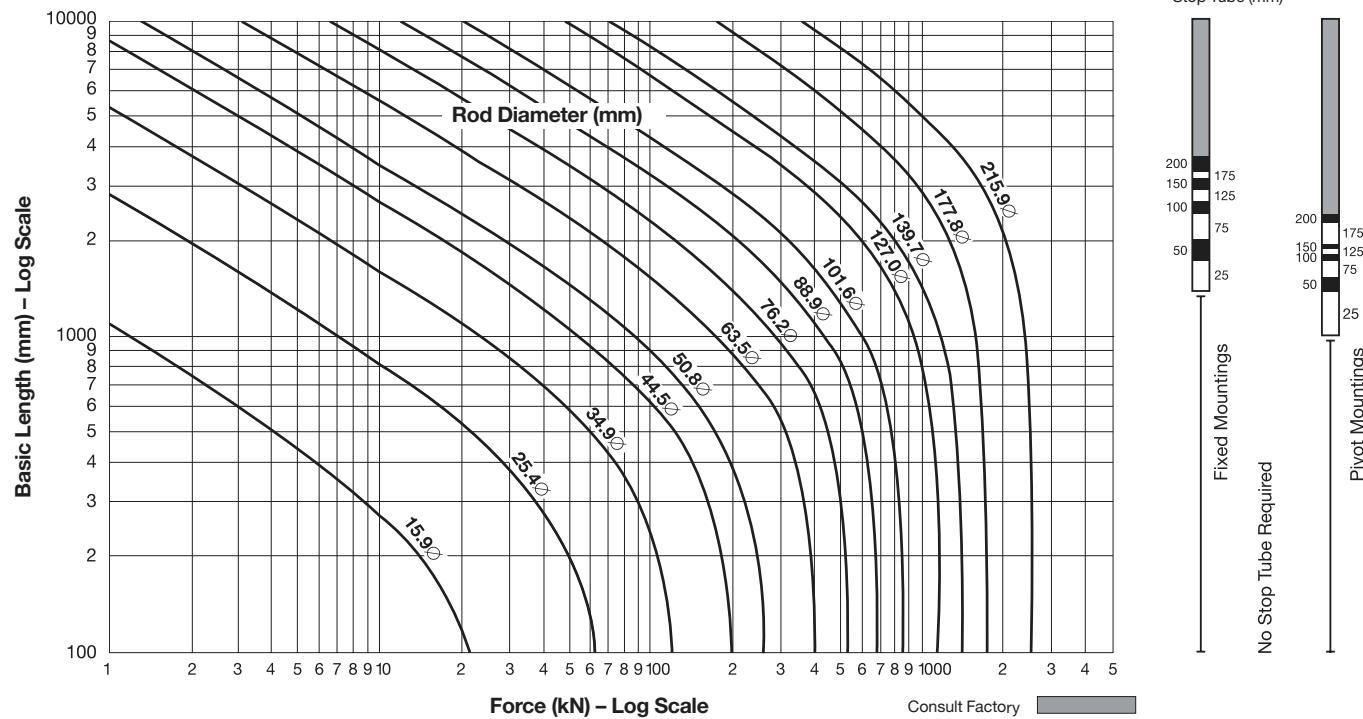
inPHorm

For accurate sizing, please refer to the European cylinder inPHorm selection program HY07-1260/Eur.

Stroke Factor Selection

| Rod End Connection | Mounting Style | Type of Mounting | Stroke Factor |
|----------------------------------|----------------------------|--|---------------|
| Fixed and Rigidly Guided | TB, TD, J, JB, JJ, C, F, G |  | 0.5 |
| Pivoted and Rigidly Guided | TB, TD, J, JB, JJ, C, F, G |  | 0.7 |
| Fixed and Rigidly Guided | TC, H, HB, HH |  | 1.0 |
| Pivoted and Rigidly Guided | D |  | 1.0 |
| Pivoted and Rigidly Guided | TC, H, HB, HH, DD |  | 1.5 |
| Supported but not Rigidly Guided | TB, TD, J, JB, JJ, C, F, G |  | 2.0 |
| Pivoted and Rigidly Guided | BB, DB, SB |  | 2.0 |
| Supported but not Rigidly Guided | TC, H, HB, HH |  | 4.0 |
| Supported but not Rigidly Guided | BB, DB, SB |  | 4.0 |

Piston Rod Selection Chart



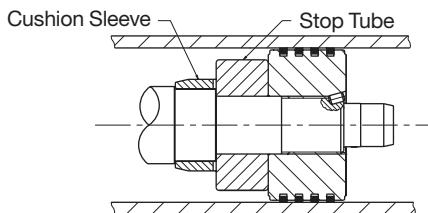
Long Strokes and Stop Tubes

For long stroke cylinders under compressive (push) loads, a stop tube should be used to reduce bearing stress. The required length of stop tube is read from the vertical columns on the right of the chart by following the horizontal band within which the point of intersection lies. Note that stop tube requirements differ for fixed and pivot mounted cylinders.

If the required length of stop tube is in the region labelled 'consult factory', please submit the following information:

1. Cylinder mounting style.
2. Rod end connection and method of guiding load.
3. Bore required, stroke, length of rod extension (dimension W or WF - dimension V - see pages 3 and 40) if greater than standard.
4. Mounting position of cylinder. (Note if at an angle or vertical, and specify the direction of the piston rod.)
5. Operating pressure of cylinder, if limited to less than the standard pressure for the cylinder selected.

When specifying a cylinder with a stop tube, please insert an S (Special) and the net stroke of the cylinder in the order code and state the length of the stop tube. Note that net stroke is equal to the gross stroke of the cylinder less the length of the stop tube. The gross stroke determines the envelope dimensions of the cylinder.



Standard Ports

Series 2H cylinders are supplied as standard with BSPP ports to ISO 228/1, spot faced for sealing washers. Metric threaded ports to DIN 3852 Pt.1 and ISO 6149, or NPTF ports in sizes as shown for BSPP ports, can be supplied if required.

Oversize Ports

For higher speed applications, oversize ports can be supplied in all bore sizes, but are not available on Style JJ mounting (please consult the factory). Ports one size larger than standard are the maximum that can be accommodated in most heads or caps within the standard envelope dimensions. Oversize or additional ports can be supplied on the sides of heads and caps that are not occupied by cushion valves. All oversize ports require welded port bosses, which protrude from the side of the cylinder.

Note that Y and P dimensions may vary slightly to accommodate oversize ports – please contact the factory where these dimensions are critical.

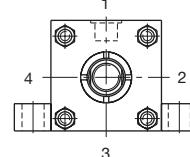
Port Size and Piston Speed

The tables show piston speeds for standard and oversize ports and connecting lines where the velocity of the fluid is 5m/s. Due to piston rod displacement, the flow at the cap end port will be greater than that at the head end, at the same piston speed. If the desired piston speed results in a fluid flow in excess of 5m/s, larger lines with two ports per cap should be considered. For cylinders with oversize ports and with a fluid velocity exceeding 8m/s into the cap end, please consult the factory with details of the application. Parker recommends that a flow rate of 12m/s in connecting lines should not be exceeded.

Where large masses are involved, or piston speeds exceed 0.1m/s and the piston will make a full stroke, cushions are recommended – see page 36.

**Ports, Air Bleeds and
Cushion Adjustment Location**

The table below shows standard positions for ports, and cushion adjusting screws where fitted. Many mounting styles can be assembled with ports located at 90° or 180° from standard. In these cases, cushion needle and check valves, where fitted, are also repositioned since their relation with the port position does not change. Air bleeds, see page 8, may be fitted in unoccupied faces of the head or cap, depending on mounting.



| Positions of Ports and Cushion Screws in Head and Cap | | Mounting Styles | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---------|---------------------------------------|---|---|---|----|---|---|---|----|---|---|---|---|---|---|---|----|---|---|---|----|---|---|---|-------|---|---|---|---|---|
| Head | Port | TB, TC, TD, J, JB, H, HB, BB & SBa | | | | JJ | | | | HH | | | | C | | D | | DB | | | | DD | | | | G & F | | | | | |
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 1 | 1 | 1 | 3 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | |
| | | 2 | 3 | 4 | 1 | 3 | 3 | 1 | 1 | 3 | 3 | 1 | 1 | 2 | 3 | 1 | 1 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Cap | Port | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | |
| | Cushion | 2 | 3 | 4 | 1 | 3 | 4 | 1 | 2 | 3 | 3 | 1 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |

| Bore Ø | Standard Ports | | | | |
|----------------|------------------|--------------|------------------------------------|-----------------------|------|
| Port Size BSPP | Port size Metric | Tube Bore mm | l/min. flow at 5m/sec ¹ | Piston Speed in m/sec | |
| 38.1 (1½") | | | | | |
| G½ | M22x1.5 | | 13 | 40 | 0.58 |
| 50.8 (2") | | | | | |
| G½ | M22x1.5 | | 13 | 40 | 0.33 |
| 63.5 (2½") | | | | | |
| G½ | M22x1.5 | | 13 | 40 | 0.21 |
| 82.6 (3¼") | | | | | |
| G¾ | M27x2 | | 15 | 53 | 0.17 |
| 101.6 (4") | | | | | |
| G¾ | M27x2 | | 15 | 53 | 0.11 |
| 127.0 (5") | | | | | |
| G1 | M33x2 | | 19 | 85 | 0.08 |
| 152.4 (6") | | | | | |
| G1 | M42x2 | | 24 | 136 | 0.09 |
| 177.8 (7") | | | | | |
| G1½ | M48x2 | | 30 | 212 | 0.11 |
| 203.2 (8") | | | | | |
| G2 | M60x2 | | 38 | 340 | 0.11 |
| 254.0 (10") | | | | | |
| G2½ | M76x2 | | 50 | 589 | 0.14 |
| 304.8 (12") | | | | | |

| Bore Ø | Rod No | Oversize Ports | | | | |
|----------------|------------------|----------------|------------------------------------|-----------------------|--|--|
| Port Size BSPP | Port size Metric | Tube Bore mm | l/min. flow at 5m/sec ¹ | Piston Speed in m/sec | | |
| 38.1 (1½") | 1 | | | | | |
| | 2 | | | | | |
| 50.8 (2") | 1 | | | | | |
| | 2 | | | | | |
| 63.5 (2½") | 1 | | | | | |
| | 2 | | | | | |
| 82.6 (3¼") | 1 | | | | | |
| | 2 | | | | | |
| 101.6 (4") | All | | | | | |
| 127.0 (5") | All | | | | | |
| 152.4 (6") | All | | | | | |
| 177.8 (7") | All | | | | | |
| 203.2 (8") | All | | | | | |
| 254.0 (10") | All | | | | | |
| 304.8 (12") | All | | | | | |

¹ This refers to fluid velocity in connecting lines, not piston velocity

² Supplied with welded port bosses at both head and cap

³ Supplied with welded port bosses at cap only

Manifold Ports

Manifold ports are available on all mounting styles to special order. Side mounted cylinders (Style C) can be supplied with the cylinder ports arranged for mounting and sealing to a manifold surface – see page 31.

Flange Ports

Flange ports are available on most large bore 2H series cylinders. Please consult the factory for details.

All dimensions are in millimetres unless otherwise stated.

An Introduction to Cushioning

The option of cushioning is recommended as a means of controlling the deceleration of masses, or for applications where piston speeds are in excess of 0.1m/s and the piston will make a full stroke. Cushioning extends cylinder life and reduces undesirable noise and hydraulic shock. Cushions can be supplied at the head and/or cap ends of a cylinder without affecting its envelope or mounting dimensions.

Standard Cushioning

Where specified, 2H cylinders use cushions which are profiled to give efficient, progressive deceleration. Final speed may be adjusted using the cushion screws.

Note that cushion performance will be affected by the use of water or high water-based fluids. Please consult the factory for details.

Alternative Forms of Cushioning

Special designs can be produced to suit applications where the energy to be absorbed exceeds the standard cushion performance. Please consult the factory for further details.

Cushion Length

2H cylinders incorporate the longest cushion sleeve and spear that can be accommodated within the standard envelope without reducing the rod bearing and piston bearing lengths – see table of cushion lengths below.

Cushion Calculations

Modelling the cushion performance on uniform deceleration, the formulae below can be used to determine the approximate force developed in the cushion chamber when decelerating a load.

Formulae

$F = ma + A_d P/10 + mgsin\alpha - f$
(for inclined or vertically downward direction of mass)

$F = ma + A_d P/10 - mgsin\alpha - f$
(for inclined or vertically upward direction of mass)

Where:

F = total force acting on the cushion chamber in Newtons
 m = mass of load in kilogrammes (including piston, rod, and rod end accessories, see table and pages 27 to 29)

a = deceleration in m/s^2 , derived from the formula

$$a = \frac{v^2}{2s \times 10^{-3}}$$

where: v = piston velocity in m/s
 s = cushion length in mm

A_d = piston area subjected to pressure, in mm^2 (see page 31)

P = pump pressure in bar

g = acceleration due to gravity = $9.81m/s^2$

α = angle to the horizontal in degrees

f = friction forces in Newtons = $mg \times 0.15$

Example

The following example shows how to calculate horizontal deceleration ($\alpha=0$).

Selected bore/rod 127/50.8mm (No. 1 rod)
Pressure = 35 bar
Mass = 2268kg
Velocity = 0.6m/s
Cushion length = 27mm
Friction coefficient = 0.15 or 3337N

$$F = ma + A_d P/10$$

$$\text{where } a = \frac{0.6^2}{2 \times 27 \times 10^{-3}} = 6.66 \text{ m/s}^2$$

$$\text{and } F = 2268 \times 6.66 + 12670 \times 35/10 - 3337 = 56128\text{N}$$

The total deceleration force is developed by the fluid compressed in the cushion chamber. This pressure is approximately equal to the force divided by the annular area (cylinder bore area - rod area):

$$\frac{56128\text{N}}{12670\text{mm}^2 - 2020\text{mm}^2} = 5.3\text{N/mm}^2 \text{ or } 53 \text{ bar.}$$

This induced pressure should not exceed 320 bar.

Cushion Length and Piston and Rod Mass

| Bore Ø | Rod No. | MM Rod Diameter | Cushion Length | | Piston & Rod at Zero stroke kg | Rod only per 10mm Stroke kg |
|----------------|---------|-----------------|----------------|------|--------------------------------|-----------------------------|
| | | | Head | Cap | | |
| 38.1 (1½") | 1 | 15.9 (5/8") | 28.6 | 30.2 | 0.45 | 0.02 |
| | 2 | 25.4 (1") | | | 0.73 | 0.04 |
| 50.8 (2") | 1 | 25.4 (1") | 28.6 | 28.6 | 0.97 | 0.04 |
| | 2 | 34.9 (1⅝") | | | 1.49 | 0.07 |
| 63.5 (2½") | 1 | 25.4 (1") | 28.6 | 28.6 | 1.36 | 0.04 |
| | 2 | 44.5 (1⅜") | | | 2.66 | 0.12 |
| | 3 | 34.9 (1⅝") | | | 1.87 | 0.07 |
| 82.6 (3¼") | 1 | 34.9 (1⅝") | 34.9 | 33.3 | 2.83 | 0.07 |
| | 2 | 50.8 (2") | | | 4.34 | 0.16 |
| | 3 | 44.5 (1⅜") | | | 3.64 | 0.12 |
| 101.6 (4") | 1 | 44.5 (1⅜") | 34.9 | | 4.99 | 0.12 |
| | 2 | 63.5 (2½") | | | 7.71 | 0.25 |
| | 3 | 50.8 (2") | | | 5.68 | 0.16 |
| 127.0 (5") | 1 | 50.8 (2") | 27.0 | | 8.73 | 0.16 |
| | 2 | 88.9 (3½") | | | 15.70 | 0.48 |
| | 3 | 63.5 (2½") | | | 10.75 | 0.25 |
| | 4 | 76.2 (3") | | | 13.19 | 0.35 |
| 152.4 (6") | 1 | 63.5 (2½") | 33.3 | 38.1 | 14.98 | 0.25 |
| | 2 | 101.6 (4") | | | 23.88 | 0.63 |
| | 3 | 76.2 (3") | | | 17.49 | 0.35 |
| | 4 | 88.9 (3½") | | | 20.09 | 0.48 |
| 177.8 (7") | 1 | 76.2 (3") | 46.0 | | 22.28 | 0.35 |
| | 2 | 127.0 (5") | | | 39.59 | 0.98 |
| | 3 | 88.9 (3½") | | | 25.03 | 0.48 |
| | 4 | 101.6 (4") | | | 29.01 | 0.63 |
| 203.2 (8") | 1 | 88.9 (3½") | 49.2 | | 33.04 | 0.48 |
| | 2 | 139.7 (5½") | | | 54.78 | 1.19 |
| | 3 | 101.6 (4") | | | 37.11 | 0.63 |
| | 5 | 127.0 (5") | | | 47.91 | 0.98 |
| | 1 | 127.0 (5") | | | 76.38 | 0.98 |
| 254.0 (10") | 2 | 177.8 (7") | | | 105.39 | 1.92 |
| | 1 | | 50.8 | | 120.47 | 1.19 |
| 304.8 (12") | 1 | 139.7 (5½") | | | 177.25 | 2.84 |
| | 2 | 215.9 (8½") | | | | |

All dimensions are in millimetres unless otherwise stated.

| Fluid Group | Seal Materials – a combination of: | Fluid Medium to ISO 6743/4-1982 | Temperature Range |
|-------------|---|--|-------------------|
| 1 | Nitrile (NBR), PTFE, enhanced polyurethane (AU) | Mineral Oil HH, HL, HLP, HLP-D, HM, MIL-H-5606 oil, air, nitrogen | -20°C to +80°C |
| 2 | Nitrile (NBR), PTFE | Water glycol (HFC) | -20°C to +60°C |
| 5 | Fluorocarbon elastomer (FPM), PTFE | Fire resistant fluids based on phosphate esters (HFD-R) Also suitable for hydraulic oil at high temperatures or in hot environments. Not suitable for use with Skydrol. See fluid manufacturer's recommendations. | -15°C to +150°C |
| 6 | Various compounds including nitrile, polyamide, enhanced polyurethane, fluorocarbon elastomers and PTFE | Water Oil in water emulsion 95/5 (HFA) | +5°C to +50°C |
| 7 | | Water in oil emulsion 60/40 (HFB) | +5°C to +50°C |

Operating Medium

The table above is a guide to the sealing compounds and operating parameters of the materials used for rod gland, piston and body seals. If there is doubt regarding seal compatibility with the operating medium, please consult the factory.

Notes

Group 1 Seals are manufactured from an enhanced polyurethane and do not require a gland seal back-up washer. They should not be used if the working fluid is water glycol. **Group 6 Seals** – System pressure should not exceed 70 bar when using HFA fluids.

Temperature

Where operating conditions fall outside those specified in the table, please contact the factory.

Green Fluids

Seals for use with specific 'green fluids' are available to special order. Please consult the factory for details.

External Fluids

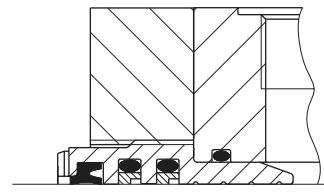
The environment in which a cylinder is used may cause fluids such as cutting fluids, coolants, and wash down fluids, to come into contact with the external surfaces of the cylinder. These fluids may attack the seals, and must be taken into account when selecting and specifying seal compounds.

Special Seal Designs and Materials

In addition to the standard and optional seals shown in the table, special seals can also be supplied – please consult the factory with details of the application. Please insert an S (Special) in the order code and specify fluid medium when ordering.

Low Friction Seals

For applications where very low friction and an absence of stick-slip are important, the option of low friction seals is available. In low pressure applications, their use should also be considered. If in doubt, please consult the factory. The gland seals comprise two low friction PTFE stepped seals and a conventional double lip wiper.



Water Service

Modifications for use with water as the fluid medium include a stainless steel piston rod with lipseal piston, and plating of internal surfaces. When ordering, please specify the maximum operating pressure or load/speed conditions, as the stainless steel rod is of lower tensile strength than the standard material.

Warranty

Parker Hannifin warrants cylinders modified for water or high water content fluid service to be free of defects in materials or workmanship, but cannot accept responsibility for premature failure caused by excessive wear resulting from lack of lubricity, or where failure is caused by corrosion, electrolysis or mineral deposits within the cylinder.

Filtration

For maximum component life, the system should be protected from contamination by effective filtration. Fluid cleanliness should be in accordance with ISO 4406. The quality of filtration should be in accordance with the appropriate ISO standards.

The rating of the filter medium depends on the system components and the application. The minimum required for hydraulic systems should be class 19/15 to ISO 4406, which equates to $24\mu(\beta_{10} \geq 75)$ to ISO 4572.

Service Assemblies and Seal Kits

When ordering Service Assemblies and Seal Kits, please refer to the identification plate on the cylinder body, and supply the following information:

Serial Number - Bore - Stroke - Model Number - Fluid Type

Key to Part Numbers

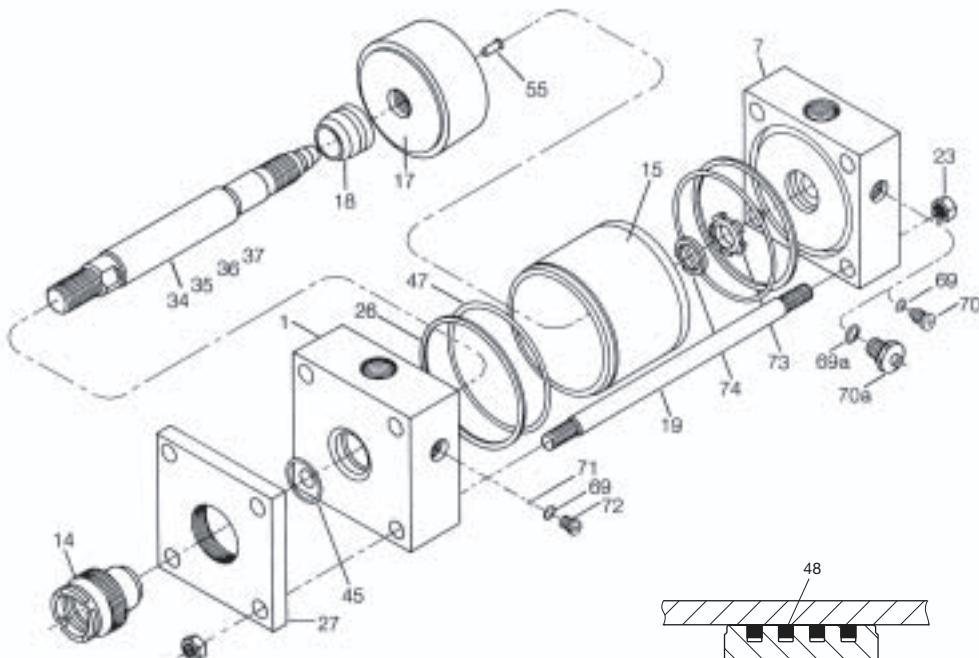
- 1 Head
- 7 Cap
- 14 Gland/bearing cartridge
- 15 Cylinder body
- 17 Piston
- 18 Cushion sleeve
- 19 Tie rod
- 23 Tie rod nut
- 26 Back-up washer – only on 177.8mm to 304.8mm (7" to 12") bore cylinders
- 27 Retainer
- 34 Piston rod – single rod, no cushion

- 61¹ Piston rod – double (weaker²) rod, cushion one end
- 69 O-ring – needle valve and check valve screws
- 69a O-ring – cartridge-type needle valve
- 70 Needle valve, cushion adjustment – bore sizes above 63.5mm (2 $\frac{1}{2}$ ")
- 70a Needle valve assembly, cartridge type – bore sizes up to 63.5mm (2 $\frac{1}{2}$ ")
- 71 Ball – cushion check valve – bore sizes above 101.6mm (4")
- 72 Cushion check valve screw – bore sizes above 101.6mm (4")
- 73 Floating cushion bush
- 74 Retaining ring for cushion bush
- 119 PTFE rings (Hi-Load piston)
- 120 Rubber pre-load rings (Hi-Load piston)
- 121 Wear rings (Hi-Load piston)

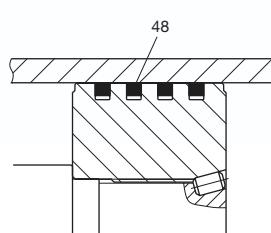
¹ Not illustrated

² See page 26 – double rod strength

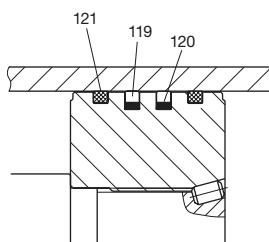
| Piston Rod Ø | Gland Cartridge Wrench | Spanner Wrench |
|--------------|------------------------|----------------|
| 15.9 | 69590 | 11676 |
| 25.4 | 69591 | 11676 |
| 34.9 | 69592 | 11703 |
| 44.5 | 69593 | 11677 |
| 50.8 | 69594 | 11677 |
| 63.5 | 69595 | 11677 |
| 76.2 | 69596 | 11677 |
| 88.9 | 69597 | 11677 |
| 101.6 | 69598 | 11677 |
| 127.0 | 69599 | 11678 |
| 139.7 | 69600 | 11678 |
| 177.8 | — | — |
| 215.9 | — | — |



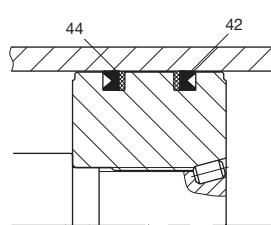
- 35 Piston rod – single rod, cushion at head end
- 36 Piston rod – single rod, cushion at cap end
- 37 Piston rod – single rod, cushion at both ends
- 40 Wiperseal – for gland
- 41 Lipseal – for gland
- 42 Lipseal – for Lipseal piston
- 43 Back-up washer – for gland lipseal 41
(Groups 2, 5, 6 & 7 seals)
- 44 Back-up washer – for Lipseal piston
- 45 O-ring – gland/head
- 47 O-ring – cylinder body
- 48 Cast iron piston ring
- 55 Locking pin – piston/rod
- 57¹ Piston rod – double (stronger²) rod, no cushion
- 58¹ Piston rod – double (stronger²) rod, cushion one end
- 60¹ Piston rod – double (weaker²) rod, no cushion



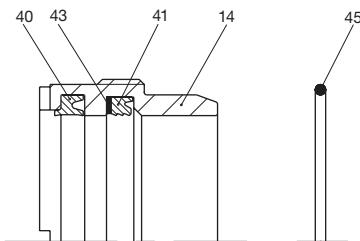
Cast Iron Piston



Hi-Load Piston



Lipseal Piston



Gland Cartridge and Seals

Piston and Gland Service Kits

(see key to part numbers opposite)

Gland Service Cartridge Kit Contain items 14, 40, 41, 43, 45. Where the original gland incorporates a gland drain, please consult the factory.

Gland Service Kit Contain items 40, 41, 43, 45.

| Piston Rod Ø | Gland Service Cartridge Kit * Standard Seals | Gland Service Kit * Standard Seals |
|----------------------------|--|------------------------------------|
| 15.9 (5/8") | RG2HLTS061 | RK2HLTS061 |
| 25.4 (1") | RG2HLTS101 | RK2HLTS101 |
| 34.9 (13/8") | RG2HLTS131 | RK2HLTS131 |
| 44.5 (13/4") | RG2HLTS171 | RK2HLTS171 |
| 50.8 (2") | RG2HLTS201 | RK2HLTS201 |
| 63.5 (21/2") | RG2HLTS251 | RK2HLTS251 |
| 76.2 (3") | RG2HLTS301 | RK2HLTS301 |
| 88.9 (31/2") | RG2HLTS351 | RK2HLTS351 |
| 101.6 (4") | RG2HLTS401 | RK2HLTS401 |
| 127.0 (5") | RG2HLTS501 | RK2HLTS501 |
| 139.7 (51/2") ¹ | RG2HLTS551 | RK2HLTS551 |
| 127.0 (5") ¹ | RG902HTS501 | RK902HTS501 |
| 139.7 (51/2") ² | RG922HTS551 | RK922HTS551 |
| 177.8 (7") ¹ | RG902HLF701 | RK902HLF701 |
| 215.8 (81/2") ² | RG922HLF851 | RK922HLF851 |

¹254.0mm (10") bore size only ² 304.8 mm (12") bore size only

Piston Service Kit, Cast Iron Rings Contains two each of items 26 (where fitted) and 47, plus four of item 48.

Piston Service Kit, Lipseal Piston Contains two each of items 26 (where fitted), 42, 44 and 47.

Piston Service Kit, Hi-Load Piston Contains two each of items 26 (where fitted), 47, 119, 120 and 121.

| Bore Ø | Piston Service Kit Cast Iron Rings | Piston Service Kit * Lipseal Piston | Piston Service Kit * Hi-Load Piston |
|--------------|------------------------------------|-------------------------------------|-------------------------------------|
| 38.1 (11/2") | PR152H001 | PK152HLL01 | PK152HK001 |
| 50.8 (2") | PR202H001 | PK202HLL01 | PK202HK001 |
| 63.5 (21/2") | PR252H001 | PK252HLL01 | PK252HK001 |
| 82.6 (31/4") | PR322H001 | PK322HLL01 | PK322HK001 |
| 101.6 (4") | PR402H001 | PK402HLL01 | PK402HK001 |
| 127.0 (5") | PR502H001 | PK502HLL01 | PK502HK001 |
| 152.4 (6") | PR602H001 | PK602HLL01 | PK602HK001 |
| 177.8 (7") | PR702H001 | PK702HLL01 | PK702HK001 |
| 203.2 (8") | PR802H001 | PK802HLL01 | PK802HK001 |
| 254.0 (10") | PR902H001 | PK902HLL01 | PK902HK001 |
| 304.8 (12") | PR922H001 | PK922HLL01 | PK922HK001 |

*** Seal Groups – Ordering**

The kit numbers shown above are for Group 1 seals. For Group 2, 5, 6 or 7 gland seals, substitute 'AHL' for 'HLTS' where used, and replace the '1' at the end of the number sequence with '2', '5', '6' or '7'. For example, a Group 5 Gland Service Cartridge Kit for a 50.8mm rod will be RG2AHL205. For Group 2, 5, 6 or 7 piston seals, substitute a '2', '5', '6' or '7' for the '1' at the end of the number sequence.

All dimensions are in millimetres unless otherwise stated.

Tie Rod Cylinders**2H Series****Contents of Service Assembly Kits**

(see key to part numbers opposite)

Head Assembly

Non-cushioned: 1, 26, 47
Cushioned: 1, 26, 47, 69, (69a), 70, (70a)

Cap Assembly

Non-cushioned: 7, 26, 47
Cushioned: 7, 26, 47, 69, (69a), 70, (70a), 73, 74

Cylinder Body

All types: 15

Cushion Screw/Cartridge Assembly

Screw type: 69, 70
Cartridge type: 69a, 70a

Check Valve Screw Assembly

Screw type: 69, 71, 72 (bore sizes above 101.6mm)

Piston Rod Assemblies

These kits contain a fully assembled piston and rod assembly and are available with the following piston and rod types:

Piston Types

Cast Iron Ring: 17, 48
Lipseal: 17, 42, 44
Hi-Load: 17, 119, 120, 121

Rod Types

| | |
|-------------------------------------|----------------|
| Single rod, non-cushioned: | 34 |
| Single rod, cushioned head: | 35, 18 |
| Single rod, cushioned cap: | 36 |
| Single rod, cushioned both ends: | 37, 18 |
| Double rod, non-cushioned: | 57, 60, |
| Double rod, cushioned stronger end: | 58, 60, 18 |
| Double rod, cushioned weaker end: | 58, 61, 18 |
| Double rod, cushioned both ends: | 58, 61, 18 x 2 |

Tie Rod Torques

Please refer to the table on page 30.

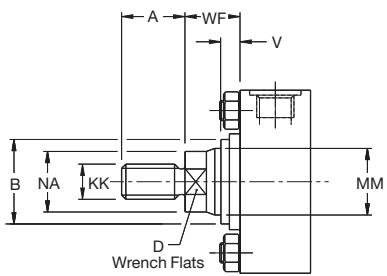
Repairs

Although 2H cylinders are designed to make on-site maintenance or repairs as easy as possible, some operations can only be carried out in our factory. It is standard policy to fit a cylinder returned to the factory for repair with those replacement parts which are necessary to return it to 'as good as new' condition. Should the condition of the returned cylinder be such that repair would be uneconomical, you will be notified.

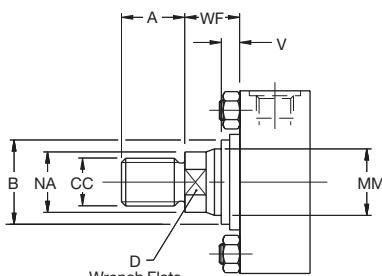
254.0mm & 304.8mm (10" & 12") Bores Only

Rod End Details – All Except J, JB and JJ Mountings

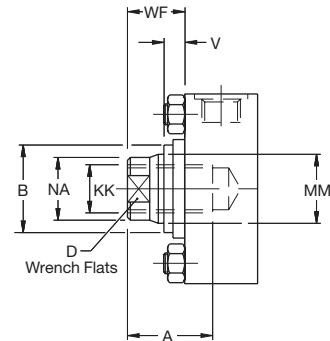
Rod End Style 4



Rod End Style 8

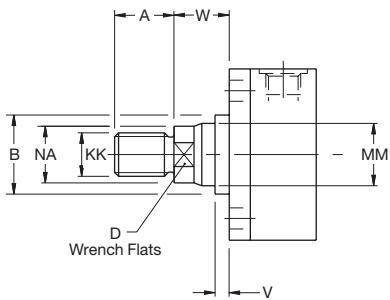


Rod End Style 9

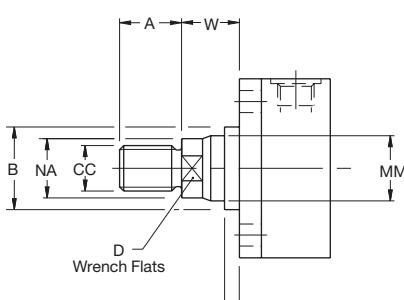


Rod End Details – J and JB Mountings

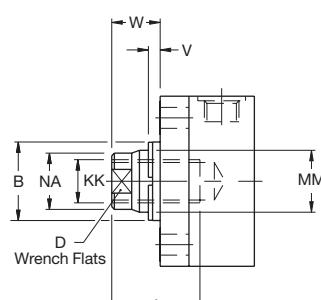
Rod End Style 4



Rod End Style 8

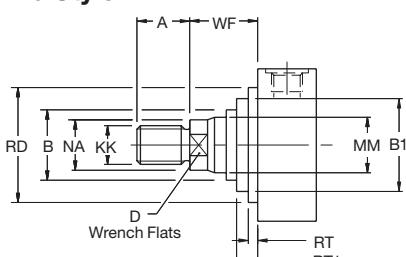


Rod End Style 9



Rod End Details – JJ Mounting

Rod End Style 4



Rod End Styles 4 & 8

Style 4 rod ends are recommended for all applications in which the work piece is secured against the rod shoulder. Where the work piece is not shouldered, Style 8 rod ends are recommended. If rod end style is not specified, Style 4 will be supplied.

Rod End Style 9

For applications where a female thread is required.

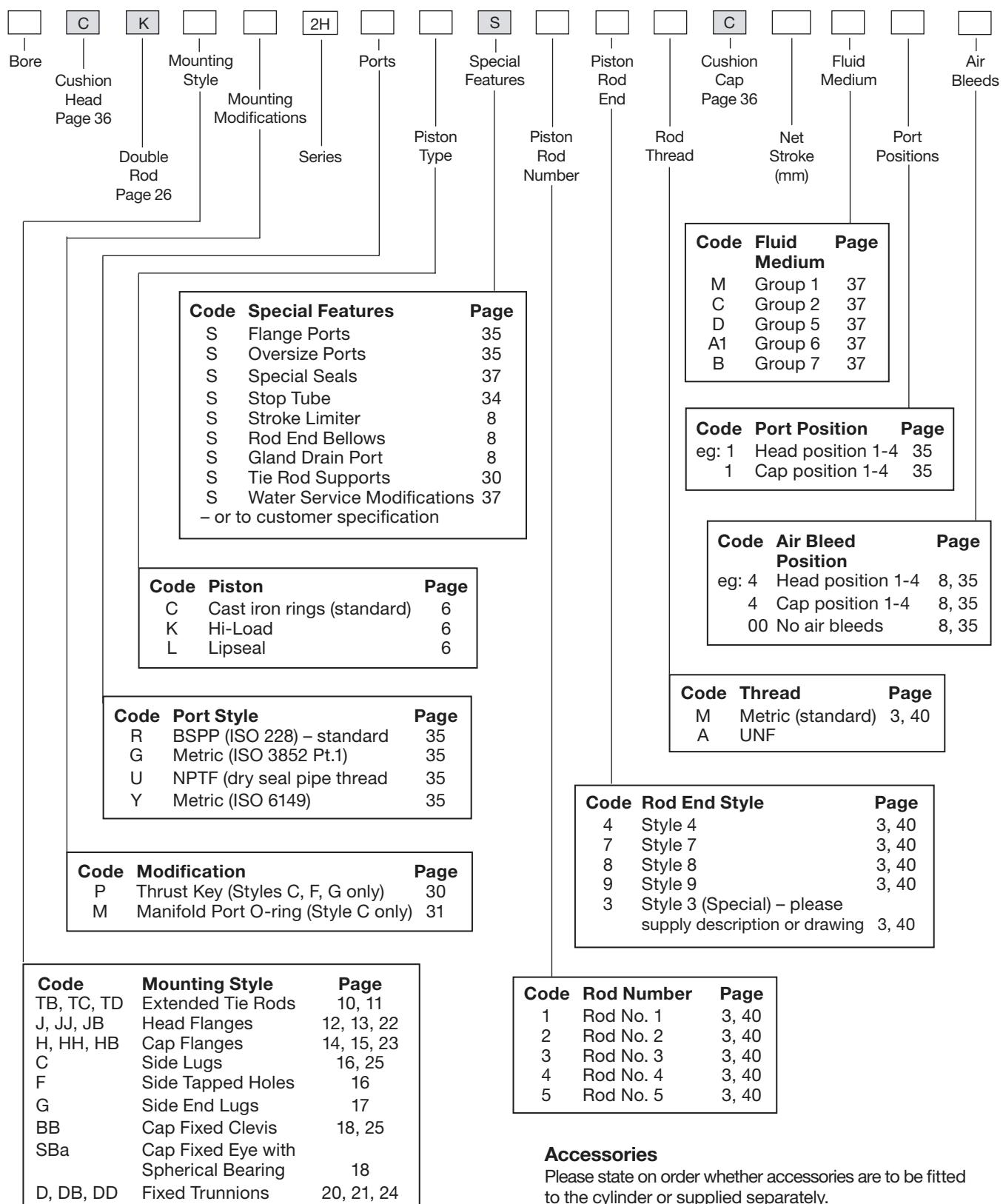
Rod End Style 3

Non-standard piston rod ends are designated 'Style 3'. A dimensional sketch or description should accompany the order. Please specify dimensions KK or CC, and A.

Rod End Dimensions – 254.0mm & 304.2mm (10" & 12") Bore Sizes Only

| Bore Ø | Rod No. | MM Rod Diameter | Style 4 & 9 | | Style 8 | | A | B +0.00 -0.13 | D | NA | V | W | WF | JJ Mount Only | | | |
|----------------|---------|-----------------|-------------|---------|-----------|---------|-----|------------------|-----|-------|----|----|------|---------------|---------|------|------|
| | | | KK Metric | KK UNF | CC Metric | CC UNF | | | | | | | | B1 | RD max. | RT | RT1 |
| 254.0 (10") | 1 | 127.0 (5") | M90x2 | 3½ - 12 | M110x2 | 4¾ - 12 | 127 | 146.0 | 110 | 123.8 | 7 | 32 | 74.9 | — | 241.3 | 25.4 | — |
| | 2 | 177.8 (7") | M100x2 | 4 - 12 | M130x2 | 4¾ - 12 | 127 | 196.8 | 150 | 174.6 | 13 | 38 | 81.0 | 214.3 | 273.1 | 28.6 | 41.7 |
| 304.8 (12") | 1 | 139.7 (5½") | M100x2 | 4 - 12 | M130x2 | 5¼ - 12 | 140 | 158.7 | 120 | 136.5 | 7 | 32 | 82.0 | — | 206.4 | 33.3 | — |
| | 2 | 215.9 (8½") | M115x2 | 4½ - 12 | M130x2 | 5½ - 12 | 140 | 234.9 | 180 | 212.7 | 13 | 38 | 87.2 | 260.3 | 336.6 | 28.6 | 46.1 |

All dimensions are in millimetres unless otherwise stated.

**Double Rod Cylinders – Example**

100 K JJ 2H R K 1 4 M 1 4 M 125 D 11 44

Key

All selections



Indicate optional features or leave blank



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